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Telephone: FLEet Street 3212 (26 Lines)
Telegrams: Allangas - Fleet - London

Editor M. C. HYDE
Manager H. A. WILLMOTT
Director N. B. LIVINGSTONE WALLACE

Midland Office
Daimler House, Paradise Street, Birmingham. [Midland 0784-5]

Leeds Office
Martins Bank Chambers, Park Row, Leeds 1. [Leeds 22601]

Scottish Office
116 Hope Street, Glasgow, C2. [Central 3954-5]

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CHEMICAL AGE

BOUVERIE HOUSE · 154 FLEET STREET · LONDON · EC4

H-POWER PROGRESS

IT was apparent from a visit to Harwell last week, that the Atomic Energy Research Establishment has made more progress along the road to electric power from thermonuclear reactions than had previously been gathered from the somewhat guarded statements made last autumn in Parliament. Apart from the high temperatures achieved and the relatively long periods during which they have been contained, the size of the apparatus Zeta, the advances made in measuring temperatures, the techniques developed to suppress instability during the reactions, and the scope and range of both instrumentation and electrical equipment, indicate an advanced state of development, particularly for what is admittedly the first and experimental stage of the project.

Great play has been made in the national Press of the fact that even with their smaller budget (Zeta cost only £300,000) and staff of 50, the Harwell team is ahead of its American counterparts. That is something of which British scientists can be justifiably proud. But now that the preliminary work has been declassified, both in the UK and the US, it is to be hoped that the physicists and engineers concerned with the experiments in both countries can be allowed to continue their valuable co-operation in an atmosphere of harmony, without a background of intense national competition. A healthy rivalry can be an effective spur to both teams, but it should be kept within bounds.

For the UK Atomic Energy Authority, Sir John Cockcroft indicated last week that the next step will be the design and construction of a much larger torus. He said that the higher temperatures and longer containment times—both vital for the economic success of a thermonuclear power station—could only be achieved by a scaling-up process. While the experiments with Zeta are continuing with a view to improving on the existing performance, the Harwell team will be designing and building a successor with the aim of achieving the point at which the energy produced equals input.

There would appear to be no unsurmountable difficulties in this respect. At any rate those engaged on the project are extremely confident; at the same time, they freely acknowledge that many major problems have yet to be solved. As the experiments are scaled up, the measurement of much higher temperatures will have to be overcome with new techniques. It seems likely that electrical equipment of a type not yet envisaged will have to be designed. For the time being, the team is not too concerned with the problem of how the energy created will be harnessed. In this respect, however, Dr. P. C. Thonemann, leader of the Zeta group, hopes it will be possible to utilise the energy directly, as opposed to the less efficient and more conventional means of steam generation.

It must be many years before the glittering prospects of energy from fusion can be realised. Estimates range from 10 to 50 years; Sir John Cockcroft thinks it will be 20 years-plus. Certainly there is room for an optimistic outlook here. Firstly, there can be no doubt that the first stage has been fully mastered and many of the problems likely to be encountered in the next stage of reaching the 'break-even' point have already come to light; secondly, the results so far achieved have been better than might have been expected in theory.

It is not yet possible to consider the eventual economics of thermonuclear generated power in more than very general terms. At present processed deuterium is purchased from the US at a cost of 2s per gramme. The next torus is likely to be very costly, particularly if there is a switch to titanium or one of the other rare metals rather than aluminium. While the initial cost of building the first commercial power station will doubtless be high, it is encouraging to remember that the cost of getting power from nuclear energy has fallen over recent years.

In any event, there can be no doubt that the development of the Zeta project to its logical conclusion is a vital necessity. As a nation we cannot afford not to develop this new and limitless source of energy. Apart from this consideration, there is the great advantage that provided the more difficult but more economically attractive route to energy from deuterium—as against a tritium-deuterium reaction—is followed, there will not be the problem of radioactive wastes that is involved in nuclear energy.

The thermonuclear project has so far received all the money from the Government that has been sought. There is no reason to expect that this situation will not continue now that a greatly enhanced expenditure is becoming necessary. In deciding the level of investment in this work, Whitehall should consider the desirability of relying on the US for deuterium. With the scaling-up of the project it is important that we should be developing our own heavy water source with an eye to the time when thermonuclear energy will be a commercial proposition.

METAL BORIDE DEVELOPMENTS

IT can be rightly said that the most spectacular advances in inorganic chemistry have been in the field of boron chemistry. However, that this has occurred is due in very great part to organic chemistry and military needs, and is undoubtedly leading to a new type of inorganic chemistry.

Recently (see CHEMICAL AGE, 18 January, p. 164) there was an announcement published from Borax Consolidated Ltd., regarding the availability of metal borides such as those of chromium, molybdenum and tungsten and of the less common metals, titanium, zirconium, vanadium, niobium and tantalum. What is the reason for the interest in these metal borons? The borides are, by virtue of high melting points (up to 3100°C) and their hardness, of considerable metallurgical interest. Also the borides have been found to show marked corrosion resistanee, both to noxious gases and to liquid or gaseous metals.

The increasingly high standards required for high-temperature-resistant materials used in development of gas turbines, rocket drives and atomic power plants has resulted in new compounds being tested, among them borides because of their inert character. In particular the borides of the metals of the fourth, fifth and sixth periodic groups of elements are characterised by high melting points, extreme hardness (Mohs hardness between 8 and 9) and high conductivity at all temperatures.

The high stability of borides, apart from those with a high metal content compared with carbides and nitrides, derives from the strength of the B-B bond which also produces a homogeneous structure. In fact, according to the boron content there can be obtained B-atoms, B-chains, double chains, B-cross links and B-lattices, which are described as akin to the structure of silicates.

Most important of the borides is chromium boride, which with nickel added is stated to make a high-temperature and scale-resistant material. Other borides of interest are titanium boride and zirconium boride which have been tried as high-temperature-resistant materials. Zirconium boride is reported as having excellent electric conductivity, which is said to exceed even that of pure zirconium. Work on zirconium and titanium borides is still in the trial phase, but studies to date have indicated that these compounds are very brittle, but have excellent time-creep strength and good scale resistance. Chromium boride with nickel chromium binder has been on sale as a flame-path director in the US for some time from the Borolite Corporation under the trade name Borolite.

Fabrication techniques for metal borides are being investigated, both from the point of view of pressing by powder metallurgy techniques and of forming coatings on metals or alloys. Because of the hardness and refractory nature of metal borides, they can be used in tools and dyes. Many metal borides are now used as components of cermets (metal-ceramic compounds) for high-temperature refractory materials technology. Considerable interest is being shown in such cermets by zinc, aluminium and uranium concerns. In particular, borides of hafnium, tungsten and zirconium have been suggested for use as control rod materials for atomic reactors.

Borides appear to have a great deal in common with true metals. Thus, they have a high electrical conductivity and a positive co-efficient of electrical resistance. Chemical borides are usually attacked by water, but dilute acids are mentioned as decomposing some of them. Those excluded from acid attack are borides of alkaline earth metals and aluminium. An interesting point here is that the higher the metal content, the more easily is the boride attacked by acid. According to reports borides have not been found to be strongly resistant to oxidation at high temperature, being attacked above temperatures of 1300°C to 1500°C. This finding limits the usefulness of their refractory properties therefore. These can only be utilised to the full *in vacuo* or in neutral or reducing atmospheres.

JAPAN'S NEW FIBRE

NOW being experimentally produced by Toyo Koatsu Industries in Japan is a new synthetic polymer stated to yield a fibre with exceptional properties. The polymer is described as a polycondensation product of nonamethylene diamine and urea.

The diamine is produced from azelaic acid by ammonation and dehydration of the nitrile, followed by hydrogenation to the diamine.

The fibre, generically named a 'polyurea' fibre, has been given the trade name Urylon. Patents have been taken out by the Toyo company in Japan, Britain, France, and Switzerland and patents in the US are stated to be pending.

The properties of Urylon are stated to be as follows: Wet strength is similar to dry strength (5-5.58/d.): lighter than nylon or Terylene (sp. gr. 1.07); melting point 240°C to 250°C; elongation of 15 to 20 per cent.

The wet strength makes Urylon a useful fibre for fishing nets (an important consideration for Japan). Its lightness is also a useful factor here. The higher melting point compared with nylon is valuable. Elongation at 15 to 20 per cent, although equal to Terylene is lower than that of nylon.

It is understood that construction work on a Urylon plant will be begun soon near the Toyo company's ammonium sulphate and urea plants at Sunagawa, Hokkaido. Initial output is expected to be one ton a day by the end of 1958. There will be a gradual increase in output to 15 to 20 tons a day.

RAPID PROGRESS IN HARWELL'S THERMONUCLEAR EXPERIMENTS

Details of Zeta Project Declassified

THE ambition of scientists to emulate the stars and to produce in the laboratory temperatures so high that useful energy can be produced from fusion reactors is now within measurable distance. First stage of the Harwell thermonuclear project has been completed by the achievement of temperatures of about 5 million degrees for long enough to allow the production of fusion reactions in deuterium gas at low pressure.

Last week details of the work and the torus Zeta in which this temperature was attained were declassified by the UK Atomic Energy Authority. Simultaneously, the US Atomic Energy Commission released details of its work in this field. The results of research teams in both countries are summarised here.

At a press conference last week at Harwell, Sir John Cockcroft outlined the progress made by the Zeta team and spoke in general terms of plans for the future. Neither he nor any members of the scientists engaged on the project would admit that the neutrons so far produced were definitely caused by a fusion reaction. Sir John said he was 90 per cent convinced that they were thermonuclear neutrons, while Dr. Peter Thonemann, leader of the Zeta group, under Mr. D. W. Fry, head of the general physics division, said that they would not be able to establish definitely the nature of the neutrons until the temperatures achieved had been raised. He hoped that the source of the neutrons would be established shortly, when a statement would be made.

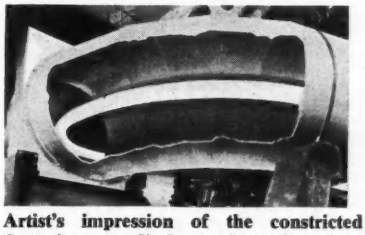
Clearly Ahead of US

When questioned, neither Sir John nor any of the team would say whether the work at Harwell was ahead of that being carried out by the US AEC. It is quite clear, however, writes a member of CHEMICAL AGE staff who visited the Atomic Energy Research Establishment at Harwell last week, that even with a smaller budget (Zeta cost only £300,000) experimental work is more advanced in the UK. High temperatures have been held in Zeta for three-thousandths of a second at 10-second intervals; in America temperatures have been maintained for millionths of a second.

The apparatus Zeta, only one of a number of tori at Harwell, is the largest in the western world. A research group of Associated Electrical Industries Ltd. at Aldermaston, under Dr. T E. Allibone, also has a torus, named Sceptre III, which is about half-way in size between Zeta and the Perhapsatron at California University, Los Alamos. To the Harwell team must go the credit for having devised a spectrometric technique of measuring the high temperatures recorded; they also devised the use of an axial magnetic field that has largely eliminated what was proving to be a dangerous instability in the reaction.

The AERE thermonuclear unit realised some time ago that to obtain higher temperatures and to contain them for relatively long periods, it was necessary to build a large torus. Zeta has an inside bore of 1 m., compared with the 2.65 cm. bore of the Perhapsatron. Already a larger version of Zeta is being planned.

The reaction being studied in Zeta (zero-energy thermonuclear assembly) is that in which deuterons (nuclei of the heavy hydrogen isotope deuterium) collide and fuse to form heavier nuclei, releasing



Artist's impression of the constricted deuterium gas discharge that takes place in Zeta

energy and some neutrons in the process. At present, however, the energy produced in the reaction is only a fraction of the energy input. It is now intended to increase the temperatures substantially. When 25 million degrees is reached, the number of neutrons per pulse should increase by about at least 10,000 times. To produce as much energy as is put in, temperatures of about 100 million degrees in deuterium gas and about 40 million in a mixture of deuterium and tritium would be required.

So while experiments with Zeta continue, the research unit will be designing and building its successor which will aim at achieving the break-even point.

New methods may be needed to heat the gas to higher temperatures and new techniques will be needed to measure them. The third stage will be the design and construction of a practical and economic thermonuclear power station. The fourth and final stage will be commercial application.

An important factor in future work will be the material of which the ring-shaped torus is constructed. At present 1-in. thick aluminium is used, and other materials have been tested in the mark III torus, immediate predecessor of Zeta. Ceramics have been ruled out because of the possibility of chemical decomposition should the torus wall become bombarded with neutrons; alumina as a coating to aluminium has been tested. The unit believes that the best answer might lie in the rarer metals, such as titanium.

The US torus, the Perhapsatron S-3, is a glass ring; but it is to be replaced by a precision alumina porcelain torus. In other US experiments, reactions have been carried out in straight tubes.

Workers in the US have tended to concentrate on the straight discharge tube, as opposed to the doughnut-shaped torus. The new Stellarator project of the AEC, to be built at Princeton University, design of which will be an improvement of earlier models such as Stellarators A and B, Columbus and Perhapsatron, will be a hollow cylindrical tube enclosed in magnetic coils. Stellarator C will be much larger than its predecessors and larger than Harwell's Zeta. It is expected to be commissioned in a few years from now.

Deuterium, the raw material for Zeta, is processed in the US and purchased at a cost of 2s per gramme. One gramme of deuterium when reacted in the torus would produce the energy equivalent from 10 tons of coal.

Alternative Routes

In an introductory talk at Harwell last week, Mr. D. W. Fry, head of the AERE general physics division, said that two methods of producing energy by thermonuclear reactions had been studied. The first was the deuterium route:

$$_1H^2 + {}_1H^2 \rightarrow {}_2He^4 + \text{energy}$$

The second would involve the use of tritium:

$$_1H^3 + {}_1H^1 \rightarrow {}_2He^4 + \text{energy}$$

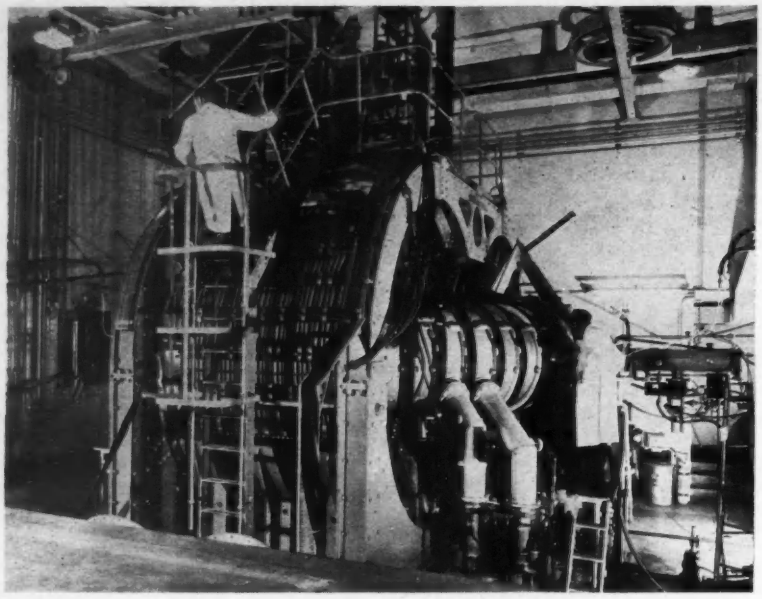
It would be preferable to use the second route as energy could be created at lower temperatures. The breakeven temperature using tritium and deuterium would be about 40 million degrees C, compared with 300 million degrees C with deuterium gas. However, from the economic point of view, deuterium was of much greater interest. The source of this material is limitless, whereas tritium is about as plentiful as uranium also its use poses the problem of disposal of radioactive wastes.

The route to tritium, should it be used, would be:

$$_3Li^6 + {}_0n^1 \rightarrow {}_2He^4 + {}_1H^3$$

The UK AEA stated this week that work on modifying Zeta with the aim of higher temperatures and longer containment times is already in hand. There will be a big increase in the condenser banks from which pulses of energy are taken. Maximum pulse currents will be raised from 200,000 amp. to about 500,000 amp. A spectacular increase in pulse duration, from 5-thousandths of a second to most of a second will also be effected.

Modification work will proceed in stages to allow experiments to continue.



General view of the 1-m. bore torus Zeta, encircled by its transformer. In the background, Philip Dawson stands in front of the vacuum spectrograph

Zeta Principles and Measurement Methods Outlined

THE principle adopted in Zeta is to pass a large electric current through the deuterium gas. This current sets up an electric discharge in the gas which heats it and produces an intense magnetic field round the column of hot gas. This magnetic field causes the discharge to become constricted and hence heated still more. Since it also causes a certain amount of instability and distortion which lead to a bombardment of the walls by electrons and positive ions, the field in itself is not sufficient to keep the discharge away from the torus walls. When the discharge strikes the walls, the temperature drops and there is a danger of vaporising the wall itself. This instability has been suppressed by applying an axial magnetic field parallel to the discharge current.

In Zeta, the discharge chamber is a ring-shaped tube or torus of 1-m. bore and 3-m. mean diameter, containing deuterium gas at low pressure, usually about 10^{-4} mm. of mercury. Pressure is kept low by continuous pumping.

The tube is encircled by the iron core of a large pulse transformer. A current pulse of electricity is passed into the primary winding of the transformer and in turn it induces a large unidirectional pulse of current in the gas, which forms a short-circuited secondary for the transformer. Peak currents up to 200,000 amp. have been passed through the ionised gas for periods of up to 4 m.sec. and they are repeated every 10 seconds. Up to 3 million neutrons are emitted per pulse.

Because at the temperature of the discharge the hot deuterium atoms are completely stripped of their electrons and therefore do not emit a line spectrum, measurement presents special problems. The Doppler broadening of spark lines emitted in a radial direction is used for estimating the kinetic ion temperature of deuterium and neon discharges. Small quantities of impurities, such as oxygen and nitrogen introduced into deuterium discharges, provide spark lines in a convenient part of the spectrum. The breadth of the lines is of the order of 1 Å. and can be measured with a quartz spectrograph having a dispersion of 20 Å./mm.

Some 300 emission lines have been identified in the wave-length range 400–2,500 Å. The most prominent are those of oxygen, nitrogen, aluminium and carbon. In this wave-length range more than 400 lines remain unidentified. Ion temperatures were found to decrease with increasing initial pressure of deuterium. No satisfactory measurement of electron temperature has yet been made.

As the gas atoms are moving in all directions, the spectrum line is not shifted but is broadened and from the breadth of the line it is possible to determine the temperature of the gas. A vacuum spectrograph is attached direct to the torus and uses a diffraction grating instead of a prism to split the light up into its component wavelengths.

Perhapsatron S-3, the 2.65cm bore US torus at Los Alamos

Temperatures in the region of 2 to 5 million degrees have been indicated. While temperatures in this range are needed to explain the observed rate of neutron production on the basis of a thermonuclear process, electric fields in the gas arising from instabilities, can also accelerate deuterium ions and lead to nuclear reactions. Such a finding was described by Academician Kurchatov in a lecture at Harwell in 1956.

In principle, the thermonuclear process can be identified by calculating the velocity distribution of the reacting deuterium ions from an exact determination of both the energy and direction of emission of the neutrons. The neutron flux so far obtained is insufficient to attain the desired accuracy of measurement.

The high temperature achieved in Zeta and the relatively long duration for which the hot gas has been isolated from the tube walls are the most important experimental results obtained so far. While a much longer time (perhaps several seconds) is needed for a useful power output, the AERE believes that there appears to be no fundamental reason why these longer times, together with much higher temperatures, cannot be achieved. There are, however, major problems still to be solved before its practical application can be seriously considered and the work is expected to remain in the research stage for many years yet.

Contractors and sub-contractors for Zeta were Metropolitan Vickers Electrical, Manchester, main contractors for construction of Zeta and collaborators in the design; Telcon Magnetic Cores, Glasgow, large ring type transformer cores; Permali, Gloucester, insulating and supporting material for transformer; Wm. Beardmore and Co., Glasgow, heat treatment of large transformer cores; A. E. Cawkell, Southall, special electronic equipment; Edison Swan Electrical, Glasgow, electric cables; Standard Telephones and Cables, Ltd., Harlow, rectifier equipment; British Insulated and Callenders Cables, Helsby, condensers; Lee and Wilkes, Birmingham, copper tubes; Geo. King, Ltd., Stevenage, cranes and hoists; Dynamo and Motor Repairs, Wembley Park, motor-generator set; W. E. Chivers, Devizes, building work; British Thomson-Houston, Rugby, ignition switches.

AEI Ltd.'s Torus Sceptre III

THEIR work with Sceptre III has been published by Associated Electrical Industries Ltd. The type of approach followed by both AERE and AEI has been the pinched toroidal discharge.

Sceptre III, like Zeta, is also an aluminium torus. It is made of 12-in.-diameter tubing, mean ring diameter being 45 in. Currents up to 200,000 amp. have been introduced into the gas and a temperature of 4 million degrees was first recorded four weeks ago. The AEI unit is pressing on with improving the efficiency of its use of electrical energy to achieve a plasma of even higher temperature, because the number of neutrons produced rises rapidly with temperature, being a thousand-million times the present number if the temperature is raised 10 times.

US SCIENTISTS' WORK ON SOURCE OF NEUTRONS

'Nature' Papers Summarised

OF the seven papers published in last week's issue of *Nature*, five were contributed by US scientists, and are summarised here. The two from UK sources were 'Production of high temperatures and nuclear reactions in a gas discharge,' by Dr. P. C. Thonemann, *et al.* (AERE, Harwell) and 'A stabilised high-current toroidal discharge producing high temperatures', by Dr. N. L. Allen, *et al.* (AEI research laboratory, Aldermaston).

The first US paper by L. C. Burkhardt, R. H. Lovberg and J. A. Phillips, deals with a method for determining the product of the temperature and the number of particles per unit volume. Such measurements amount to a determination of the effective temperature of the hot gas. This technique, using measurements of the magnetic field in the gas, is fully described.

The second paper, by D. D. Hagerman and J. W. Mather, describes the production of neutrons in a straight pinch tube. The apparatus, called Columbus II, began to yield significant results last summer. Columbus II was designed to pour electric power into the pinch tube in as short a time as possible.

Under various conditions the tube can be made to yield between 10 million and 100 million neutrons per pulse and these are emitted in a time of about one millionth of a second, or less. In actuality two currents—a small one and a large one—are applied, in succession. It was found that the number of neutrons is reduced somewhat by the application of a weak longitudinal magnetic field, but this is to be expected, according to theory.

Elaborate Tests

Elaborate tests were undertaken to determine whether most of the neutrons are produced by thermonuclear reactions, or whether they are emitted at the electrodes or walls, or from instabilities in the gas. The neutron yield increased by a factor of two when the voltage was raised from 40 to 50 kilovolts. By catching the neutrons in sensitive photographic plates placed around the discharge tube it was possible to study the question, does their energy correspond to a case in which the deuterons are moving in all directions or to a case in which they are moving with great speed toward the cathode? Both groups should be expected. It was found, however, that there was a group of deuterons travelling toward the cathode with a speed of 70 million centimetres per second.

L. C. Burkhardt and R. H. Lovberg in the third paper deal with a straight pinch tube called Columbus S-4. It was constructed to study the effect of greater length and greater tube diameter. The tube is a porcelain cylinder five inches in diameter and twenty-four inches long. It showed that there can be circulating currents in the tube at certain times during the pinch process. There are indications that particle energies of 300 electron volts (or temperatures of about three million degrees) were attained, in spite of the fact that it was operated at voltages below 20 kilovolts.

Perhaps the most significant observation with S-4 is that the field produced by the pinch current is highly reproducible over several half-cycles of the applied voltage.

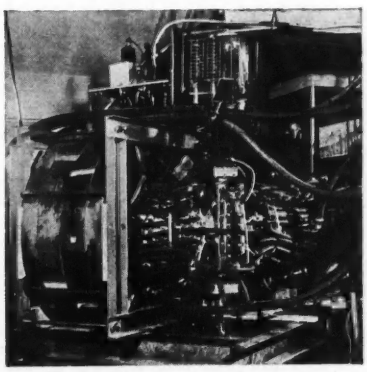
The production of neutrons from a stabilised pinch in a small torus, Perhapsatron S-3 is dealt with by J. Honsaker, H. Kerr, J. Osher, J. Phillips and J. L. Tuck. This tube, which came into operation in December, 1957, yields as many as a million neutrons per discharge, under suitable conditions. The main burst of neutrons occurs in a time of about two microseconds. Smaller bursts continue to occur for several additional microseconds. It is stated that the results are consistent with an effective temperature of about 6 million degrees. There is good evidence that the pinch is well centred while the applied current is high. It undulates slightly, but the motion has an amplitude of only about two millimetres. These observations suggest that the discharge is well-stabilised; herein lies their great interest.

'False' Neutrons

Results on 'false' neutrons obtained at Berkeley and Livermore are discussed by the UCRL group, in a letter to the *Physical Review* (24 January, 1957). After describing many interesting experiments these writers conclude that 'a thermonuclear yield cannot be proven by a large number of corroborating neutron measurements, but instead must in addition be in agreement with a basic understanding, and with measurements of the plasma physics.'

British results with Zeta are analysed by L. Spitzer, Jr., professor of astronomy at Princeton University, and director of Project Matterhorn (*Nature*, 1958, 181, (24 January)). His analysis shows that the deuterons in Zeta must be accelerated to the observed high temperatures by some unknown process.

When a strong discharge is produced in deuterium gas, the deuterum atoms are split up into their component elements—electrons and deuterons. The electric voltages applied to the gas in Zeta would be expected to accelerate the electrons primarily. According to theoretical expectations, the accelerated electrons then impart their energy to the deuterons in elastic collisions, as between billiard balls. The analysis by Spitzer indicates that the rate at which deuterons can be accelerated by such collisions is too slow to explain the observed rate at which the deuterons in Zeta are accelerated to energies corresponding to several million degrees. Hence some unknown process must be effective in Zeta.



Sceptre III, the small torus in which the hydrogen fusion reaction has been controlled at the research establishment of AEI Ltd., Aldermaston

THERMONUCLEAR QUOTES

- **While we are experimenting with Zeta, improving it and studying its performance we will be designing and building its successor which will aim at achieving the 'break-even' point.**—SIR JOHN COCKCROFT.
- **We are indebted to the AERE, Harwell, for assistance in handling this paper for publication simultaneously with the Zeta experiments (which, incidentally, preceded this work by several months).**—J. HONSAKER, *et al.*, *Nature*, **25 January, page 231.**
- **Within 12-15 months we hope to increase the current and hold the gas a little longer. We will be getting on with this work as soon as the thermonuclear group returns to normal routine.**—DR. P. C. THONEMANN.
- **British progress in controlled thermonuclear fusion shows that very significant results can be obtained under more austere conditions than exist in the United States.**—ADMIRAL L. L. STRAUSS, **chairman, US Atomic Energy Commission.**
- **The work (on Sceptre III) has been supported for the most part by a contract from the AEA; the AEI company has invested the balance of the cost in the interests of science and in the firm belief that the difficult problems of this work will in due course be resolved.**—ASSOCIATED ELECTRICAL INDUSTRIES LTD.
- **I agree that this achievement ranks very high in the history of British science.**—MR. R. A. BUTLER, **Home Secretary.**

H-POWER REACTORS COMPARED

Apparatus	Type	Bore Diameter	Max. Current Pulse	Highest Temperatures million °C.	Time Contained	Neutrons per Pulse millions
UNITED KINGDOM						
Zeta, Harwell ...	Torus, aluminium	1 m.	200,000 amp.	5	3.5 m.sec.	3
Sceptre III, AEI Ltd.	Torus, aluminium	30 cm.	200,000 amp.	4	3.5 m.sec.	—
UNITED STATES						
Perhapsatron, Los Alamos ...	Torus, quartz	2.65 cm.	200,000 amp.	6*	6 μsec.	1
Columbus II, Los Alamos ...	Straight tube, porcelain	—	800,000 amp.	5*	1 μsec.	10-100
Columbus, S-4, Los Alamos ...	Straight tube, porcelain	5 in.	250,000 amp.	3*	6 μsec.	0.01

*Estimated.

A Remarkable Scientific Achievement

IN his statement at Harwell last week, Sir John Cockcroft said 'I consider that to have achieved temperatures which are a third of those at the centre of the sun and to hold them for so long is a remarkable scientific achievement, and I have no doubt that within a year Zeta, with some modifications, will far surpass the sun's central temperature.'

Referring to the close co-operation with the US AEI, he declared: 'The Perhapsatron work in the US, together with the results obtained by AEI and our work with Zeta, enable us for the first time to see the effect of the size of the apparatus on performance'. If the performance of the three tori of increasing size was examined, one was given a good guide for their future line of development and the conditions required to increase the time during which the high temperatures persisted.

Long containment times were as important as high temperatures for practical results and one of the objectives would be to achieve much longer containment times as well as 'break-even' temperatures. The performance of Zeta had encouraged them to believe that that would be possible.

Perhapsatron used an axial magnetic field rather stronger than that of Zeta. Pulses of currents of up to 200,000 amp. up to 60 millionths of a second were passed through the conducting gas channel. Up to a million neutrons per pulse were observed. This neutron emission would be consistent with a temperature of about 6 million degrees C, but temperatures were not measured. Temperatures had been measured spectroscopically only in Zeta and in the AEI Sceptre III.

Harwell's Thermonuclear Team

THE work on Zeta has been done in the general physics division at Harwell which is under the direction of MR. D. W. FRY, who during the war took part in the research and development of centimetric radar. Aged 47, he was appointed chief physicist of the Atomic Energy Research Establishment in 1954.

The group responsible for the work on Zeta has been led by DR. PETER THONEMANN. Dr. Thonemann's interest in thermonuclear reactions goes back to his undergraduate days at the University of Melbourne, where he presented a thesis on the subject in 1946. For this work he was awarded an M.Sc. degree. He has been actively engaged in research in gas discharge physics for more than 10 years, first at the Clarendon Laboratory, Oxford, and since 1951 at Harwell. He gained his Ph.D. for his work at Oxford which led to the production of the RF type of proton source, which is now used almost universally in laboratories equipped with high voltage sets for the acceleration of ion beams.

Dr. Peter Thonemann, who heads the Zeta group.

Senior members of the Zeta team have been MR. R. CARRUTHERS, who has been engaged in research on various synchrotrons, MR. R. S. PEASE (from 1947 to 1955 specialising in solid state research, particularly irradiation damage and neutron diffraction), MR. J. T. D. MITCHELL, assistant chief engineer with AERE engineering division, and DR. W. B. THOMPSON, a Canadian, who went to Harwell on a senior research fellowship after having published two papers on the energy distribution of plutonium fission fragments.

Crosfield Contract for Matthew Hall

MATTHEW HALL AND CO. have been awarded a contract for the design, procurement, construction and commissioning of the new chemicals building at the factory of Joseph Crosfield and Sons Ltd. at Warrington. This covers a new chemical plant for the manufacture of industrial detergents, silica gels and other chemicals, which is due to be completed in July 1959.

The value of the contract to Matthew Hall is approximately £1 million.

Big Demand for Salt

Demands for salt for snow clearing have jumped to 2,200 tons a day. Normal output of salt from the ICI salt division plant at Winsford, Cheshire, is about 400 tons a week.

Benger's Sue for Patent Infringement

LEGAL proceedings have been commenced in the district court of Iowa, US by Benger Laboratories Ltd. against Fort Dodge Laboratories Inc. Benger seek an injunction to prevent Fort Dodge infringing their US Patent 2,820,740, 'Therapeutic preparation of iron' which was issued on 21 January. They claim general damages, costs and 'such further and other relief as may seem proper to the court.'

The Benger patent covers iron-dextran complex marketed in most countries of the world under the name Imferon. In the US Imferon is manufactured under licence by Lakeside Laboratories Inc. of Milwaukee, Wisconsin. The veterinary form of the product is similarly licensed by Benger to the Armour Laboratories Inc. of Kankakee, Illinois, and is marketed under the name Armidexan.

Iron-dextran complex (Imferon) was discovered by Benger research workers, and marketed in 1954. The product in both medical and veterinary forms is claimed to be earning a rapidly increasing dollar income.

Mr. Frank Fowler, Benger's technical manager, has just returned from discussion in Chicago with Merriam, Lorch and Smith, the company's attorneys in this action.

Burma and Unilever Plan Soap Plant

JOINT venture between the Government of Burma and Unilever Ltd. is being negotiated for the manufacture of soap to be known as Burma Unilever Ltd. Under it, the Burmese would hold 25 per cent of the shares, and Unilever would be given a fifteen-year guarantee against nationalisation with facilities for the import of equipment and raw materials and remittance rights.

Site for the factory has been made available on the Hliang river at Thamaing near Rangoon on a thirty year lease. Development of the site is to be undertaken by the government and the factory is expected to go into production in 1959, with an initial production of 5,000 tons. Burma's present annual consumption of soap is 18,000 tons.

Water Treatment Society AGM

ANNUAL general meeting of the Society for Water Treatment and Examination will be held on 14 March, at the Royal Society of Health, 90 Buckingham Palace Road, London SW1, from 9.30 a.m. till 5.30 p.m.

After the business meeting the following papers will be presented to the society:

(1) 'Boiler water treatment' by P. Hamer. (2) Symposium on spectrography and chromatography (a) 'Infra-red absorption spectrography', (b) 'Uv emission spectrography' by H. L. Bolton and P. J. Cooper and (c) 'Chromatography' by E. G. Laws.

SHELLHAVEN—ROMFORD PIPELINE PROJECT NOW IN FINAL STAGE

THE scheme for supplying refinery gases from the Shellhaven refinery of Shell Refining Co. to the Romford works of the North Thames Gas Board is now in its final stages of construction.

By arrangement with Shell, the NTGB will take 25 million therms a year (about 14 million cubic feet a day) of refinery gases for a period of 10 years beginning in the middle of 1958. This is equivalent to the gas produced from 250,000 tons of coal a year and represents about 6 per cent of the board's total production.

The gases to be provided are a by-product of the refining processes and at present are used for providing process heat at Shellhaven. When they are sold to NTGB their place for process heating will be taken by a cruder material, probably fuel oil.

A 24-in. steel main has been laid from Shellhaven to Romford, a distance of 15½ miles. This is said to be one of the biggest mainlaying operations ever undertaken in the UK.

At Shellhaven the preliminary purification unit is being completed by Shell, while at Romford a plant operating on the Onia-Gegi principle is being erected by Humphries and Glasgow.

Speaking to the Press on 27 January Dr. J. Burns, chief engineer, NTGB, said that it was necessary to use a steel main because of the high pressures involved (up to 400 lb. per sq. in.). Cast iron was not safe at pressures above 30 lb. per sq. in. The use of steel involved precautions against corrosion and cathodic protection was employed. The installation consisted of a transformer rectifier and a graphite groundbed installation designed to give a 25-year life. Total cost of this installation was estimated at £500 and the running cost for current at 24s a year.

Initial Load

Initial load of the pipeline will be 4 million cubic feet of rich gas a day. Potential capacity is 10 million cubic feet an hour.

Because of the corrosion problem it is necessary to purify the gas before it leaves Shellhaven. This is done in three stages. In the first the gas passes through a Girbitol process where most of the hydrogen sulphide and some organic sulphur are removed by washing with an organic solvent. In the second stage alkalis are used to remove more of the hydrogen sulphide and some organic compounds. Finally the gas is dried by alumina and passed through metering and quality controls, leaving the outlet at a pressure of 120 lb. per sq. in.

The gas will reach Romford at a pressure somewhere between 20 and 100 lb. per sq. in. This will be reduced to 7 lb. per sq. in. When the gas arrives from Shellhaven it will have a calorific value of 1,500 BThU a cubic foot and will have to be transformed to gas of 500 BThU a cubic foot before it can be passed into the mains.

The reduction will be carried out by the Onia-Gegi process in which a portion of the gas is passed over a nickel catalyst which converts the higher hydrocarbons into a mixture of mainly hydrogen, carbon monoxide and carbon dioxide with a calorific value of 320 BThU per cubic foot. This is mixed in the cold with the remainder of the incoming gas to give a material of 500 BThU per cubic foot and with the same combustion characteristics as town's gas derived from traditional raw materials.

There are four catalyst vessels at Romford and it is estimated that these will produce 36 million cubic feet of 500 BThU gas a day.

Part of the Romford plant is suited for using primary flash distillate or light spirit as a raw material in the event of failure of the supply of refinery gas.

Total cost of the process to the NTGB is £1,789,000. It is expected that it will produce as much gas as a conventional coal carbonising unit costing £4,380,000. Capital cost will be 1d a therm against 2.9d a therm by traditional plant. It will be equivalent to building a new works sufficient to supply a town of 500,000.

Three Point Rise in Price Index

PRICE index for chemical and allied products for December 1957 was 144.5 compared with 141.3 for December 1956 (June 1949 = 100). The figure for November 1957 was 144.3. A detailed breakdown of the figures is as follows:

	Dec. 1956	Nov. 1957	Dec. 1957
Dyes & dyestuffs ...	143.3	143.2	143.2
Disinfectants ...	126.5	126.5	126.5
Insecticides, weedkillers & fungicides	135.5	128.0	128.0
Synthetic resins & plastics materials	123.5	121.2	121.2
General chemicals ...	161.1	164.2	164.1
Benzole, pure BSS 136-1950	212.7	191.4	191.4
Caustic soda liquor 100 Tw	157.6	168.6	168.6
Soda ash, light (delivered)	164.5	174.5	174.5
Soda ash, light (f.o.r. works)	173.4	185.7	185.7
Sulphuric acid, BOV ...	173.7	177.2	177.2
Sulphuric acid, ROV 94/95 per cent	181.8	190.8	190.8
Drugs & pharmaceutical preparations	102.9	106.6	106.6
Soap, candles & glycerine	122.7	129.8	129.8
Soap	121.6	130.0	130.0
Synthetic detergents ...	115.8	121.1	121.1
Ethyl alcohol, industrial BSS 507-1933 ...	156.7	234.0	214.4
Carbon black	131.1	133.4	133.4
Fertilisers	199.9	198.8	201.1
Pyrites c.i.f. UK ports ...	175.8	163.0	159.5
Sulphur, crude c.i.f. ...	176.6	154.2	153.0

'Corrosion of Aluminium' Booklet

THE FORMS of chemical attack to which aluminium is susceptible are discussed in 'Aluminium with Food and Chemicals,' published by the Northern Aluminium Co. Ltd., Bush House, Aldwych, London WC2.

Halogens, salts of heavy metals and atmospheres laden with corrosive substances can cause pitting of the surface. In one respect this is said to be more serious than uniform surface attack because a comparatively small amount of local action can cause perforation. On the other hand the rate of penetration usually slows down with increasing depth and pitting is therefore not always as dangerous as would appear at first, especially on thick material.

Where the attacking agent dissolves the oxide film, a general attack of the whole surface may take place, usually resulting in a uniform surface deterioration. Since the rate tends to be uniform it is possible to predict the life of a piece of equipment.

Galvanic attack is possible where aluminium is in electrical contact with a more noble metal in the presence of an electrolyte. Zinc and cadmium can be used with aluminium but copper and copper-bearing alloys should be avoided. Stainless steel, although cathodic to aluminium, can be used in contact with it in normal atmospheres and natural waters.

Crevice corrosion is best eliminated by a smooth interior finish for vessels of all kinds. Attack tends to be accelerated at crevices between two parts of the same metal as well as at those between two dissimilar metals.

A variety of processes are available for protecting aluminium. For example, the natural oxide film can be thickened by immersing the metal in various solutions. Electrochemical processes can also be used to thicken the oxide film. This process, known as anodising, is normally more expensive than chemical treatments.

Aluminium alloys can be protected by cladding, in which the alloy is covered by a layer of pure aluminium which has a much greater corrosion resistance.

Lacquering with epoxy, alkyd, vinyl and phenolic resins is also possible and the metal can be painted if the correct preparatory procedure is carried out first.

Cathodic protection can be applied where the corrosion is electrochemical in origin. For aluminium chemical equipment the usual practice is to use a zinc anode. Corrosion inhibitors have also been employed successfully although care must be taken in their application.

Welding of Copper Cable to Pipelines

A LEAFLET from Metal and Pipeline Endurance Ltd., Artillery Mansions, Victoria Street, London SWI, describes the Mapelweld process for welding copper cable for cathodic protection to steel or cast iron pipes in which no external heat or power source is needed.

The equipment consists of a graphite mould which is placed on top of the pipe to be welded, a metal disc which is melted to form the weld, and a starting powder which is placed on top of the metal disc.

When the starting powder is ignited by a special flint gun the metal disc melts and flows over the cable, welding it to the pipeline.

★ WITH most of the technical and lay press at Harwell last week, I was impressed with the confident way that Dr. Peter Thonemann, 40-year-old leader of the Zeta group, handled his first press conference. Although more than half the questions were passed to him by Sir John Cockcroft, many of them controversial, Thonemann remained unruffled.

Just under three hundred journals and newspapers were represented. Theme for a number of questions was the alleged US pressure to delay declassification; many questions were also asked—some by Americans—on whether the UK work was ahead of that across the Atlantic. Sir John was adamant that declassification took place to an agreed schedule and would not be drawn on the comparison of progress in the two countries.

Most questioners were obviously disappointed that there was insufficient evidence to say that the neutrons so far produced were definitely caused by a thermonuclear reaction. Both the US and the UK workers decline to confirm this until further investigations have been made. Asked if it could be said that 'some' of the neutrons were a result of a fusion reaction, Dr. Thonemann said he would prefer to await the results of further experiments; he expected that a statement would be made shortly. Sir John was 90 per cent sure that these were thermonuclear neutrons. With that the press had to be satisfied.

★ ACRIDINE dyes and solar batteries would appear to be very remote from each other. However, it seems from work carried out at the Polytechnic Institute of Brooklyn, New York, US, by Gerald Osten under a US Air Force contract, that acridine dyes store up energy from sunlight which can be released on placing the dyes in the dark. In the presence of a reducing agent the dyes use 25 per cent of the radiant energy they absorb in changing into different compounds. On placing the changed dye in the dark, the energy is released and the compound reverts to the dye.

One application of this discovery could be the use of such dyes in solar batteries of earth satellites.

★ GLAXO LABORATORIES' suggestions award scheme has paid out its biggest individual award to date—£350—to Mr. D. C. Ryder, a process worker at the company's antibiotics plant at Ulverston, Lancs. The suggestion, concerning a method of electronic control of foaming during antibiotic fermentation, has led to a considerable saving in production costs.

Mr. Ryder has been with the company for ten years. During his service with the Royal Navy he worked on radar and electronics. An earlier success in the suggestions scheme gained him an award of £35.

Other big awards under the Glaxo suggestions scheme have included a joint award of £350 made in 1956 to two production workers at the company's plant at Barnard Castle and an award of £300 made last year to a member of fermentation department, Ulverston.

★ THE principle that consumers should be informed of the presence of chemical additives in their food is recommended by the joint FAO/WHO expert committee on food additives which has recently published its first report (World Health Organisation technical report 129). Label declaration is the most effective method of achieving this result, but it is pointed out that in some countries alternative approaches have been adopted.

In the US, standards of identity for foods have been laid down. These list the permitted ingredients and are available to the public.

Acknowledging the desirability of having reliable analytical methods for the detection and estimation of food additives, authorised as well as those not allowed, in each class of food, the report refers to difficulties in the development of methods for determining substances in certain groups, such as flavouring agents.

For communities where only limited chemical control can be kept, the committee recommend that permission should be confined to a small number of additives possessing particularly wide margins of safety.

★ THE TOP LEVEL changes in the Atomic Energy Authority (see People in the News, p. 244), mean that a principle recommended in the first Fleck report has been adopted. It was felt that those at the top were being overburdened. Until Sir Christopher Hinton's departure last year, three full-time members of the AEA had virtually three jobs: (1) executive control of one or more AEA establishments; (2) formulation of policy on, and broad oversight of, the subject of their special field (research, production and engineering, and weapons); (3) joint consideration and decision on the policies to be pursued by the AEA.

Sir John Cockcroft relinquishes his directorship of the AERE Harwell, but continues as the authority's full-time member for scientific research; his deputy, Dr. B. F. J. Schonland, succeeds him at Harwell; Mr. W. R. J. Cook, deputy-director of the Atomic Weapons Research Establishment, becomes AEA member for production and engineering (one of the two posts originally held by Sir Christopher Hinton—Sir Leonard Owen assumed responsibility for the other last September, that of managing director of the industrial group); Sir William Penney continues as member for weapons research and development, but will be replaced in due course as director of the AWRE.

★ THREE hundred Bristol chemistry students were told on 8 January that to put a new plastics material on the market costs from £2 million to £10 million. They also heard that in extreme cases, production and development costs could be considerably higher, as was the case with Terylene.

They learned this from Professor C. E. H. Bawn, Grant-Brunner Professor of Inorganic and Physical Chemistry, Liverpool University. Professor Bawn, a graduate of Bristol University, who was giving a lecture on 'Progress in plastics', repeated his lecture to students from outlying grammar schools between Cheltenham and Taunton.

The lecture was organised by the Bristol and district section, Royal Institute of Chemistry, and Professor Bawn was introduced by Dr. D. Woodcock, hon. secretary, who is on the staff of the Long Ashton research station.

★ TO KEEP in step with the firm's expansion and the changing demands of technology, the Ruabon works of Monsanto Chemicals Ltd. have for some years been using a training programme that aims at maintaining a steady, parallel development in the training both of supervisors and operators. There is formal training for new process workers in job methods, for supervisory levels and for new graduate staff in general industrial administration.

A special training course is provided for all production foremen to help them keep up with technological advances. Instructors are drawn from the Monsanto technical staff. Originally planned to last two years, it is now intended to extend the course as requests are made for information on other matters. The scheme might, therefore, prove the start of a continuing process of instruction and training.

Newcomers to the graduate staff engaged in the immediate supervision of production groups are assigned to the plant investigation group—concerned with technical 'trouble shooting' throughout the plant. Training is tailored so that those going into production are given a broader training than those specialising in a limited technical field.

Alembic

'Who's Who' of the Chemical Industry

MORE THAN 2,500 executives in the chemical industry and leading personalities in industrial and academic chemistry and chemical engineering are included in the 1958 edition of the 'Who's Who of the Chemical and Allied Trades' that is featured in the latest CHEMICAL AGE YEAR BOOK. Entries give qualifications, present position and address, and official posts held in learned societies, trade organisations, etc.

This edition of the Year Book also lists societies and associations concerned with chemicals and chemistry (giving addresses and names of officers and officials); similar information is given for DSIR departments and UK research associations. Government Departments and State Organisations are featured with headquarters' addresses as well as names and addresses of laboratories, research facilities, chief chemists, etc.

A Buyer's Guide to chemicals (much enlarged, as is the 'Who's Who' section) contains entries of 530 companies under 2,700 different product headings.

The Year Book is issued free to subscribers to CHEMICAL AGE. Non-subscribers can obtain copies from the Manager, CHEMICAL AGE, 154 Fleet Street, London EC4, price 21s.

'Cost of Flameproofing Will Remain High'

THE PRICE of flameproofing treatment would always remain high because of the composition of the chemical concerned. This view was expressed by Mr. F. Tattersall, of Proban Ltd. at a recent conference organised by the Birmingham Accident Prevention Society. The cost, he said, had gone down but the decrease was not significant.

Dr. J. P. Bull, head of the burns unit at Birmingham Accident Hospital, said that even if large quantities of flameproof materials were available to the public they would be bought only by those people who already took care. Most casualties came from poorer homes which would not buy the more expensive material.

It was stated at the conference that the cost of flameproof material was 50 to 75 per cent more than ordinary material.

Smaller Increase in Capital Spending

BOARD OF TRADE index numbers of fixed capital expenditure in the chemical and allied trades in the third quarter of last year (average quarterly expenditure during 1955=100) was 156, compared with 134 in the same period of 1956. Capital spending in the second quarter was at the rate of 159, against 126; and in the first quarter, 150, compared with 110. Total expenditure during 1955 was £101 millions.

The chemical and allied trades have a higher third quarter index than any other industry.

NEW EXPERIMENTAL DATA ON HIGH PRESSURE REACTIONS

MUCH new experimental data had accumulated in recent years on the effect of pressure upon the course and rate of chemical reactions and considerable progress had been made towards arriving at satisfactory explanations of the observed phenomena in terms of the kinetic theory and the theory of transition states. This was stated by Professor D. M. Newitt when he gave a lecture to a joint meeting of the Royal Institute of Chemistry and the London Section of the Society of Chemical Industry held in London recently.

Professor Newitt dealt with three different types of pressure reaction for which extensive data now exist. In the first type, which included a wide range of unimolecular and bimolecular reactions in the liquid phase, the reactants were assumed to pass through a transition state with an accompanying volume change $\triangle V_C$. The magnitude of this volume change could not, in general, be calculated but it might be found experimentally by determining the velocity constants over a sufficiently wide range of pressure.

Recent work of Hamann and of Laidler on various types of ionic reaction had shown that $\triangle V_C$ was made up of two terms, one of which included the change in volume of the reactants on passing to the transition state and the other the change in volume of the surrounding molecules due to the solvation of the ions. The values of $\triangle V_C$ were, therefore, to be correlated more with the electrical nature of the reaction than with whether it was formally considered as a bimolecular association or a unimolecular decomposition.

The second type of pressure reaction was represented by oxidation reactions in the gaseous phase. Oxidations belonged generally to the class of chain reactions which propagated by means of atoms or radicals and the course of reaction at high pressures might often be influenced by third body collisions which terminated the chains before complete oxidation had taken place. Typical examples were quoted from the paraffin and aromatic hydrocarbons.

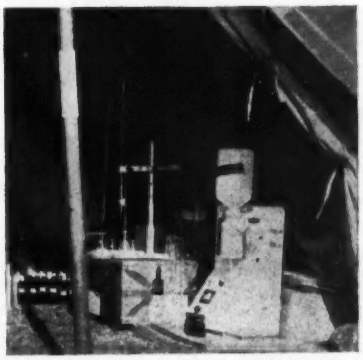
Lastly, the general effect of pressure upon polymerisation reaction was described. Many such reactions proceeded by a chain mechanism and were exothermic in character, special arrangements being necessary to ensure isothermal conditions. The extent of polymerisation and the degree of cross linking were governed by steric factors which were pressure dependent. Thus in the case of ethylene it was possible by a suitable combination of temperature and pressure and in the presence of initiators, to obtain dimers, long chain polymers and cross linked polymers which had a wide range of desirable physical and mechanical properties.

Professor Newitt concluded by mentioning certain physical transformations which theory predicts should occur at very high pressures and he referred briefly to some recent significant work in this field.

Expedition Uses Elga Deionising Unit

DISTILLED water used during the expedition made by the Nottingham University Exploration Society to Spitsbergen last year was produced by an Elgastat field unit. This is the portable deionising equipment made by Elga Products Ltd., of Railway Place, Wimbledon, London SW19.

Physiological studies were carried out by the society to investigate the influence of light and activity on sleeping and waking cycles and their associated phenomena on the behaviour of the pituitary gland. Blood counts were taken at 90-minute intervals during the morning and three-hourly during the afternoon and evening. Blood films were prepared and stained. Urine collections were made three-hourly to determine the rate of urine production. Specific gravity and pH values were measured and the ascorbic acid content determined.



Elgastat field unit in one of the expedition's tents

Deionised water equal to triple quartz distilled water was produced by the Elgastat for examinations and analyses. All the equipment had to be carried over 15 miles of difficult territory by members, and the weight of the Elgastat, with sufficient ion exchange cartridges for a three-month research programme, was 25 lb.

ICI-Hercules Methyl Methacrylate Plant Postponed

Indefinite postponement of plans to build an $11 million plant to produce methyl methacrylate at Louisiana was announced by Hercules Powder Co., of the US last Friday. This plant was to have been jointly owned with Imperial Chemical Industries Ltd.

The report states that the two companies had re-examined the markets for methacrylate and found finally that these 'did not look attractive enough' for them.

In Parliament

'TWICE AS MANY SCIENTISTS BY 1970'

ASKED when the House would learn of the reappraisal of support being given to scientific and technical education and to fundamental research promised in the NATO communique on 19 December, Mr. Ian Harvey, Joint Under-Secretary of State for Foreign Affairs, said on Monday that considerable progress had already been made.

In the light of studies already made, the Government was aiming to double the output of scientists and engineers by 1970, as compared with 1954–55.

AEA May Revert to Conventional Contract Methods

For technical reasons, the design and construction of a nuclear power station can best be undertaken by a group of companies operating under a single contract, rather than by a large number of separate companies operating under separate contracts. This was stated by Mr. Reginald Maudling, Paymaster-General, on Monday. He added that in the early stages of the nuclear programme there were four consortia which received training from Atomic Energy Authority in collaboration with the Central Electricity Authority. Since then a fifth consortium had been formed and had been given similar training.

Asked if he was aware of a widespread feeling that this business was too much of a closed circle, Mr. Maudling said that when the AEA made available valuable information to those consortia there were always terms in the contract providing for appropriate payment. No exclusive rights were granted to the use of such information.

He added: 'I agree that in the long run this system is by no means perfect, and it will always be kept under review by the Authority. There is a possibility at a later date of returning to more conventional methods.'

Implementing Fleck Proposals on Health and Safety

The Government and the Atomic Energy Authority are now working out how best to implement the recommendations of the Fleck committee on health and safety. When the AEA had completed its study of the report, it would consult the Government about the setting up of an independent inspectorate to check the safety of all nuclear establishments. This was stated in question-time on Monday by Mr. Reginald Maudling, Paymaster-General.

No Special Arrangements for Plutonium Poisoning

Mr. R. Thompson, Parliamentary Secretary, Ministry of Health, in a written answer this week, said he knew of no reason why special arrangements should be made to deal with cases of plutonium poisoning in the southern counties. Hospitals generally were equipped to deal with the toxic effects of exposure to ionising radiations, and research into the effects of such exposure from both internal and external sources was being actively pursued by the Medical Research Council's radiobiological research unit at Harwell.

Works to be Added to Alkali Act Schedule

ADDITIONS to be made to the schedule of works to be controlled under the Alkali Act have been announced by the Minister of Housing and Local Government, Mr. Henry Brooke. They are:

Iron works; steel works; copper works; aluminium works; gas and coke works; sulphate reduction works, i.e. works in which metallic sulphates are reduced to the corresponding sulphides by heating with carbonaceous matter; power stations; producer gas works; caustic soda works; and chemical incineration works.

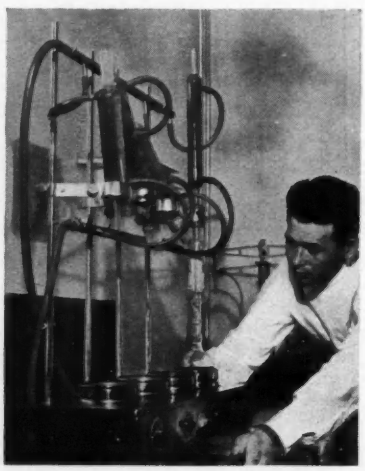
The following additions to the list of noxious gases has also been made by the Minister:

Fumes containing aluminium and its compounds; fumes containing chlorine and its compounds; fumes containing iron or its compounds; acetylene; compounds of acetylene.

The necessary order will be laid before Parliament in the near future, to come into force on the same 'Appointed Day' as the remaining provisions of the Clean Air Act 1956.

Last June a public enquiry was held by Sir Frederick Armer at which the industries concerned asked to be scheduled under the Alkali Act instead of remaining under the control of the local authority. The local authorities opposed the application.

Biostat as a Whale Preservative



At Husvik Harbour, a whaling station in the South Atlantic, a chemist analyses the fat of whales injected with a special whaling formulation of the antibiotic oxytetracycline (Biostat Pfizer Ltd.). Trials have shown that an injection at killing significantly delays carcass spoilage and gives increased oil yields.

Monopolies Report on Fertilisers Due Next Year

President of the Board of Trade is not expected to receive the report of the Monopolies Commission on fertilisers before next year. Mr. F. Willey (Lab., Sunderland N.) said that a recent authoritative report upon this industry showed the reduction in production costs has had no reflection at all in prices, which means that there must be a very high level of Government subsidy. Mr. F. J. Erroll, Parliamentary Secretary to the Board of Trade, replied that it would not be right to interefere with the work of the Commission.

New Fluorine Containing Chemical Species

THE preparation or attempted preparation of new fluorine-containing chemical species by the Simon's electrochemical process is described in LLU.PB121818*, and gives details of work carried out by H. G. Brown, R. D. Dresden, J. R. Wethington and J. A. Young, Florida University. The results of numerous operations in a variety of cells are summarised. The preparation, pyrolysis or thermal reactions of certain simple fluorocarbon sulphides with fluorocarbon olefins are described. The sulphides are CF_3SF_5, $C_2F_5SF_5$, $(CF_3)_2SF_4$ and $(C_2F_5)_2SF_4$. The olefins involved were $CF_3CF{=}CF_2$, and $CF_3N{=}CF_2$. The synthesis and properties of fluorocarbon derivatives having hetero atoms such as oxygen or nitrogen in the principal carbon chain of the molecule have been studied. Preparation of a new and unexplored class of compounds, the perfluoroamides, and the synthesis of a possible intermediate in the preparation of the difunctional acid $O(CF_2COOH)_2$ are mentioned. Preparations and reactions of perfluoroalkyl amidines, $R_FC(:NH)NH_2$, and perfluoroalkyl triazines $(R_FCN)_3$, have been studied. Efforts to use potassium and sodium vapour as a reaction medium for fluorocarbon synthesis have not been successful. Fluorine exchange between metal fluorides and fluorocarbon olefins has been studied. Exchange was generally accompanied by decomposition. It was found that the reactor packing determined the nature of the products obtained from the oxidation of C_3F_6.

* DSIR Lending Library Unit, 20 Chester Terrace, London. SW1.

Fire At Monsanto Works

There was a fire in the benzene storage tanks at the Newport plant of Monsanto Chemicals Ltd., in South Wales last Saturday. No one was injured. The blaze was confined to a small area inside the alkyl-benzene plant and was under control within twenty minutes of the arrival of the Newport brigade. Work was not interrupted, but it is not yet known whether the tanks can be used again.

Analytical Review

CHEMICAL DETECTION OF OXYGEN IN TITANIUM

A NEW approach to the determination of oxygen in titanium metal and alloys was recently described in *The Analyst* by Elwell and Peake(1). This method which is based on chlorination of the metal in the presence of graphite under an inert atmosphere of argon, results in the formation of carbon monoxide from the oxygen originally present in the alloy. The excess chlorine is removed by means of antimony and the carbon monoxide is subsequently oxidised and dealt with in the usual gravimetric fashion. This new procedure has much to recommend it in place of more commonly used methods. For example, the vacuum-fusion procedure requires costly apparatus which also has a very high depreciation value and requires no small skill in operation.

While it is a generally applicable method, it is said to fail when manganese is present. The simpler chemical technique described by Elwell and Peake works well for this type of Mn-Ti alloy. The method has several obvious advantages over previously described chemical procedures. In one of these the sample is chlorinated and the TiO_2 remaining behind after volatilisation of the $TiCl_4$ is taken as a measure of the oxygen. Corrections are necessary for the carbon monoxide produced from the carbon present in the sample, and moreover metals which yield residues of uncertain composition (e.g. aluminium) must be absent.

One of the most interesting methods hitherto described is based on bromination and subsequent chemistry which is essentially similar to that of the method reviewed here. But bromination is a slower process and the procedure which is due to Codell-Norwitz(2), has not yet proved itself to be sufficiently satisfactory in the hands of some other workers.

Time required for a determination by this new method is about 2½ hours, and allowing for stabilisation of the chlorination/combustion train, establishment of blank values from time to time, etc., it is estimated that about 12 determinations may be carried out per working week of five days using one apparatus.

Analytical characteristics of plutonium. The analytical chemistry of plutonium forms the subject of a most interesting paper in a recent issue of *Analytical Chemistry*(3). Beyond doubt the importance of this element as a factor in modern life cannot be overrated, yet in this country few chemists outside the laboratories of the Atomic Energy Authority can have much knowledge of the chemistry of this man-made element. Whilst it is not possible to review this extremely informative paper in any great detail here, it is of interest to note some of the salient features of the analytical chemistry of plutonium.

Most important of the precipitation forms are the hydroxide, dioxalate, tetraiodate, tetrafluoride, trifluoride and peroxide. In 1M HNO_3 the tetraiodate has a solubility of 1.6 mg Pu/litre. The tetrahydroxide appears to be somewhat more insoluble (1.1 mg Pu/litre) but requires long standing. Because of this appreciable solubility it is necessary to exercise precautions against the radioactivity of Pu when carrying out work on solutions from which Pu has already been precipitated.

Plutonium exists in all oxidation states from 2–6 inclusive. The divalent state is, however, not stable in aqueous solution. The trivalent state, readily produced from the tetravalent cation by a variety of substances including titanous, ferrous and iodide ions is relatively stable in aqueous solution being oxidised to the tetravalent form only very slowly The latter oxidation state is very stable. It is believed to exist in the unhydrolysed Pu^{4+} form at acidities greater than decinormal. It forms complexes with very many ions e.g. NO_3^-, $SO_4^=$, Cl^-, F^-, etc. The tetravalent ion shows a distinct tendency towards disproportionation to the hexa- and trivalent states. The pentavalent state is of minor importance but appears to exist in the range pH 2–7. It is believed to exist as PuO_2^+. The hexavalent form (PuO_2^{2+}) is very similar to the uranyl ion in its reactions.

In this article Dr. T. S. West reviews two papers. They are concerned with:

1. An elegant new method for the determination of oxygen in titanium and its alloys which appears to be more generally applicable than any method (physical or chemical) hitherto proposed.

2. The analytical chemistry of plutonium. An abstract is given here of the salient features of the chemistry of this vital man-made element as disclosed in a paper recently read at the tenth annual summer symposium of the analytical division of the American Chemical Society.

The electrochemistry of this multivalent ion is, as would be expected, of very great interest. The Pu^{3+}/Pu^{4+} and PuO_2^+/PuO_2^{2+} systems are reversible whereas the Pu^{4+}/PuO_2^+, Pu^{4+}/PuO_2^{2+} and Pu^{3+}/PuO_2^{2+} systems are non-reversible. It is not practicable to list the various potentials, but they lie very close together in the region –0.98 to –1.02 V, and it is probable that all four common oxidation states can co-exist in aqueous solution. Plutonium III does not produce a polarographic wave in the region 0.0 to –0.9 V vs S calomel electrode and it is therefore possible to determine many other metals in its presence by this technique.

In aqueous solution the spectrum of plutonium salts is characterised by a sharp-band, rare earth-type of structure which makes possible the determination of plutonium in each of its valency states. For example, in 0.5 M HCl there are bands suitable for analysis of Pu^{3+} at 600 mμ, Pu^{4+} at 470 mμ, and for PuO_2^+ at 569 mμ. In 0.5 M HNO_3 PuO_2^{2+} gives an excellent band at 833 mμ. These bands may be modified considerably by the presence of even relatively simple ions such as sulphate, etc., because of the ease with which plutonium forms complexes and in this respect the perchlorate anion is to be preferred. Measurements of adsorption spectra, etc., have led to the formulation of an order of interference due to complex formation. This is

$$SO_4^=,\ C_2H_3O_2^-,\ C_2O_4^=\ >>\ NO_3^-,$$
$$Cl^- >>-\ ClO_4^-.$$

Much work has been done on the radiochemical analysis of plutonium, of course, and many reliable methods have been evolved. The most interesting isotopes are Pu-238, 239, 240 and 241. The 239 isotope is perhaps the most important. Because of their different energies it is easily possible to distinguish the α particles from Pu-238 and Pu-239 and measure them simultaneously. Pu-240 is included in the Pu-239 peak and americium 241 (often present) in the Pu-238 peak.

While the radiometric method is generally applicable for amounts of Pu too small to be dealt with by normal chemical procedures, certain limitations are associated with its use. When low amounts of Pu (< 10 mg/l.) are present in high salt concentrations, a separation is necessary. The presence of salts is an important factor, thus a sample weight of 100 μg/sq. cm. on the counting plate will lead to 3 to 4 per cent loss of α activity due to absorption. The size of the sample to be counted is also limited. The specific activity of Pu-239 is about 71,000 counts per μg/min. in a counting chamber with 51 per cent geometry. However, a counting chamber with 51 per cent geometry and the usual type of proportional counter will not tolerate more than about 100,000 counts per minute because of losses of several per cent.

Spectrochemical Analysis

Spectrochemical analysis of impurities in plutonium presents a major problem due to the line rich spectrum of the element. Consequently separation procedures are necessary to free the impurities from plutonium. The carrier distillation method using gallium sesquioxide may be used in the d.c. arc to induce volatilisation of the impurities and/or suppress the ionisation of the plutonium. The cupferron/chloroform extraction from hydrochloric acid solution may be used for the extractive separation of plutonium from most other elements(4). Another procedure(5) referred to, extracts certain impurities into hexone from Pu^{3+} solution. Pu^{3+} is then extracted into the same solvent as its TTA complex and the impurities in the raffinate are then determined spectrographically.

Plutonium is an extremely toxic substance. The tolerance values for Pu-239 are as follows(6). Air—3.5×10^{-11} g/litre, Drinking water—2.16×10^{-5} g/

(*continued in page* 236)

RECORD EXPORTS OF CHEMICALS DRUGS AND PLASTICS

AFTER rising rapidly from 1953 to 1955, UK exports of chemicals levelled off in 1956, but the rate of growth accelerated again last year to 9½ per cent. Chemical exports in 1957 were at the record rate of £267.4 million, compared with £244.5 million in 1956 and £233 million in 1955. UK shipments of chemical elements and compounds, valued at £62 6 million in 1957, showed a rise of 5 per cent over the 1956 figure of £59.4 million; the 1955 total was £53.1 million.

Exports to Australia rose by one-quarter; Western Europe and the Argentine also took substantially more. A detailed analysis, compiled by CHEMICAL AGE from the Trade and Navigation Accounts, appears in page 245. The following table shows UK exports of chemicals to major markets:

	1955	1956	1957
		£ million	
Australia	19.45	17.61	22.31
India	16.53	18.27	16.56
South Africa	11.57	11.79	12.81
Netherlands	7.83	8.86	10.03
Italy	6.33	8.82	8.78
Canada	7.79	8.29	8.52
New Zealand	7.87	7.28	8.49
France	6.65	7.75	8.58
USA	7.61	8.64	7.38
Eire	6.74	6.63	6.76
Other countries	134.68	140.60	157.18
Total ...	233.05	244.54	267.41

Drugs and Medicines

Exports of drugs and medicines from the UK reached a new record in 1957 of £39.6 million, compared with £35.9 million in 1956 and £12.8 million in 1946.

In 1957 antibiotics accounted for nearly £9 million; miscellaneous proprietary medicines (including those for supply on prescription) accounted for nearly £11 million and vitamins for over £3 million. Exports of aspirin tablets exceeded 780 million. Synthetic antimalarials, alkaloids, barbiturates, insulin and sulphonamides also made important contributions to the total.

Australia (£3.4 million), and India (£2.9 million) were leading markets for these British exports, followed by New Zealand, South Africa, Nigeria, the Irish Republic and Burma—all taking between £1 million and £2 million. Exports to China also passed the £1 million mark—an increase of over £300,000 on the previous year.

Exports to Egypt amounted to only £83,000, as compared with £740,000 in 1956 and £1,2 million in 1955. Canada and the US accounted for over £1.5 million.

Plastics Exports Up 50%

UK exports of plastics raw materials set up a new record in 1957. More than 111,800 tons were exported, valued at £29.9 million, representing increases of nearly 14,000 tons and £3¼ million over the record levels of 1956. The tonnage represents an increase of more than 50 per cent in three years (1954 total, 73,000 tons, valued at £20¼ million).

In 1957, Australia was again the biggest buyer, with imports valued at over £4 million (against £2¼ million, 1956) and exports to France increased from £1.6 million to over £2 million. The third largest buyer was India (£1.6 million) while for New Zealand, the Netherlands, Sweden, and South Africa, the values were all over £1.5 million.

The exported materials consist of moulding powders, resins, sheet, rod, tube, film and foil, but do not include finished products or components, large amounts of which are used in such industries as aircraft, electrical and radio, and motor manufacture, nor do they include plastics machinery.

Expanding Market Forecast For Pyrethrum

AN EXPANDING market in Europe and the US can be anticipated by the pyrethrum insecticide industry according to the chairman and executive officer of the Pyrethrum Board of Kenya, Mr. D. H. Pell-Smith and Major Norman Hardy, who have just returned to Africa from a sales tour of these areas.

Present annual turnover of the African pyrethrum industry is about £2 million.

American processors, who purchase 68 per cent of the pyrethrum marketed, expressed their willingness to the Board's representatives to receive a proportion of pyrethrum in the form of extract instead of baled flowers as soon as existing contracts expire. By this means transit losses of the insecticide's constituents encountered when shipping flowers will be avoided and the cost and time of shipment will be cut.

Additional extract plants are being constructed at Nakuru, Kenya and Goma, Belgian Congo.

ILO to Discuss Industrial Relations in Chemical Industry

INDUSTRIAL relations in the chemical industries and the protection of workers against occupational diseases and poisoning will be discussed by the Chemical Industries Committee of the International Labour Organisation at its fifth session to be held in Geneva from 10 to 21 February.

The ILO report dealing with industrial relations notes that 'good relations between workers in the chemical industries and their employers are essential for industrial progress and hence for the improvement of the workers' standards of living.'

With regard to protection of the health of the workers it is stated that 'in the chemical industry, where the possibilities of exposure to toxic substances are greatest, the incidence of occupational poisoning and disease compares favourably with that of other industries.' The ILO report adds that this is a measure of the standard of care and supervision provided within the industry. At the same time, the report reveals that 'the steady increase in the production and use of chemical substances brings with it an increase in the potential risk to those concerned with their manipulation.'

A detailed analysis is given of the effects on the human body of chemical substances, by ingestion, by inhalation, or by absorption through the skin. In the chapter devoted to the prevention of diseases and poisoning, the report underlines that the first essential for preventing industrial diseases is a knowledge of the hazard. It requires the education of all interested parties—workers, management, doctors and industrial hygienists. The investigation of cases and research is indispensable for widening knowledge already existing and for the detection of new hazards which may arise.

Factory Plans Prepared

H. G. Fowler and Co. Ltd., chemical leadburning contractors, Ashmole Street, London SW8, have had plans prepared for the early erection of new factory premises at Wandsworth.

Analytical Review

(Continued from page 235)

litre. The maximum permissible daily uptake is 6.5×10^{-12} g and the total tolerance is 6×10^{-7} g, i.e. 0.6 μg. Consequently plutonium must be handled in 'dry' or 'glove' boxes with an efficient exhaust system and rubber gloves must be worn at all times in such work.

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(3) C. F. Metz, *ibid*, 1957, 29, 1748.
(4) J. E. Reinschreiber, A. L. Langhorst and M. C. Elliott, *U.S. Atomic Energy Comm. Rept.*, 1952, I.A 1354.
(5) H. H. van Tuyl, *ibid.*, HW 28530.
(6) National Bureau of Standards, 1953, *Handbook* 52.

Biggest-ever Mechanical Handling Show

THE 1958 Mechanical Handling Exhibition and Materials Handling Convention at Earls Court, London, from 7 to 17 May, will, it is said, be the largest display of labour-aiding equipment and methods ever presented to the world. It will for the first time be international in character with over 250 exhibitors displaying thousands of time and cost-saving devices from Britain, the US, France, Germany, Italy and Scandinavia. At the Materials Handling Convention, running concurrently, leading authorities will present papers dealing with the latest handling methods in particular industries.

NUCLEAR ENERGY CONFERENCE

Fission Product Disposal Discussed by K. Saddington

Two papers summarised here were presented at the British Nuclear Energy Conference held in London last week and sponsored by the Institution of Chemical Engineers. Other papers were reported in Chemical Age last week, page 195.

DISPOSAL of unwanted radioactive fission products formed during operation of a nuclear reactor will increase with increased utilisation of nuclear power. Mr. K. Saddington in 'Fission Product Disposal' discussed the nature and magnitude of this problem.

In the UK by 1965 installed electricity generating capacity will require the annual consumption of 6 to 8 tons of nuclear fuel (U^{235}), which in turn will give rise to a similar amount of fission product waste. It is expected in that year to produce fission products with an activity of 1,000 megacuries (10^9 curies) after 100 days of 'cooling.' Calculations indicate that 10^9 curies of fission products would have to be diluted with a million cubic miles of sea water in order to bring the concentration down to the level permitted in drinking water.

Available methods fall into two categories: (a) Complete containment until all or most activity has decayed; (b) Dispersion of the activity by natural or other means, so that it is greatly diluted. In practice a combination of methods is used.

Table I

Origin of Main Effluents

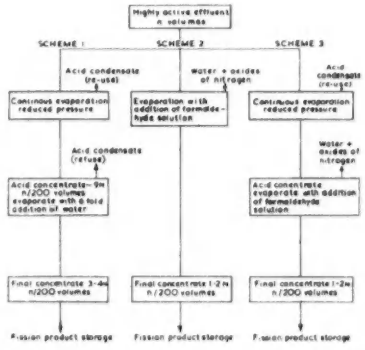
Source	Activity of Waste High	Medium	Low
Primary Separation Extractor I	X	...	...
Extractor II	...	X	...
Uranium purification ...	...	X	...
Plutonium purification ...	...	X	...
Solvent washing ...	...	X or	X
Rod storage ponds	...	...	X
Laboratories, etc.	...	...	X

Classification of Effluents

Type of Effluent	Range of $\beta\gamma$ activity per l. Solution	Daily arisings (gal.) Windscale 1956
Highly active	I—greater than 100 curies	Thousands
Medium active	Tenths—I curie	Many thousands
Low active	Trace levels—fraction of a millicurie	Millions

For highly active effluent, the present accepted practice is complete containment in leak-proof shielded storage. The high cost of this (£100 to £200/cu. m.) has led to (a) segregation of effluent to avoid dilution; (b) concentration of the effluent, the generally accepted procedure being evaporation. In connection with evaporation, mention was made by Mr. Saddington of the significant difference existing between the earlier (Hanford) Redox process and the Windscale process for treatment of unalloyed uranium. The latter was operated on a salt-free first extraction to ensure that highly-active raffinate of small solids content could be evaporated by a large factor before solids deposition. The Redox process requires the addition of initial nitrates to the feed solution. The consequent highly-active raffinate is not susceptible to concentration by evaporation to the same extent as in the Windscale (and later US Purex) process.

Mr. Saddington gave a general description of the practice at Windscale. He summarised the methods available (see following scheme). A combination of methods 1 and 2 has advantages over either, it was stated.



US practice at Hanford was described as complicated. Non-treatment of effluent before storage gave rise to surface crusting of sludge which affected subsequent attempts at concentration. Also three different separation processes have been used, giving different highly-active effluent, which requires a flexible treatment process. One novel treatment was utilisation of self-heating properties of highly-active solutions resulting in self-evaporation. Supplementary to this Hanford now use the UK method of evaporation under reduced pressure in stainless pot stills.

Storage of high activity acid concentrate in the UK is in stainless steel tanks, but in the US acid liquors are neutralised before storage in tanks lined with mild steel.

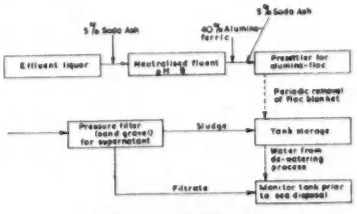
Costs of evaporation and storage were considered by Mr. Saddington. These are not strictly comparable figures, but for the UK at present the figures of £10 to £15/cu. m. of original feed is stated to agree with the US figures of 15 to 17 cents gal. (£11 to £12/cu. m.). These were operating costs only. Cost of storage of concentrate was conditioned by its nature and type of storage. US figures varied from $0.5 to $2.0/gal. (£35 to £140/cu. m.).

From a comparative cost study of storage as acid or neutralised waste, for the raffinates from the US process, it was concluded that the use of stainless steel tanks in spite of their high unit cost was the more economical.

In the US active waste is neutralised (to pH10) before final storage, polyvalent ions, iron, manganese, etc., being precipitated as hydroxides or basic salts which carry much of the fission product activity. Addition of nickel ferrocyanide gives a decontamination factor for caesium of 300-1,000. Additional decontamination from radio-strontium is obtained by the addition of calcium phosphate. In the UK both caesium and strontium are extracted to provide radiation sources for medicine and industry.

Current experimental work had as its aim the fixation of fission products as stable solids from which activity could not subsequently be reached. Two processes had received consideration, said Mr. Saddington: one was adsorption on montmorillonite clay in the US whereby as much activity as possible is removed on specially prepared clay pellets and heating these to 1,000°C to convert them to hard ceramic heads from which radioactive material cannot be leached. In the UK similar results had been obtained using 'green sand' which is fused to a glass. The second process was the conditioning of neutralised wastes with sodium nitrate to give a weight ratio of sodium nitrate to other salts of 1:1.

In an inclined-tube calciner, water was flashed off and some nitrate decomposition occurred. Finally the salts were raised to the melting point and run off as a molten stream, which was solidified in suitable containers. As leaching can occur from the solid mixture, the process is not as reliable as the first-mentioned process. Medium active effluent treatment at Windscale was outlined. Overall cost was less than £1 per cu. m. for the liquors arising from some five years of operation.



—Windscale treatment for medium active liquors

US practice for medium and low activity effluent liquors was largely based on direct disposal into the ground, using the ion-exchange properties of the latter, together with slow percolation of the residual liquor through carefully-chosen strata. Other factors involved include the invert and radioisotope concentrations and chemical composition of the liquor, composition of soil column percolation rate, direction of movement of ground water to point of public consumption, extent of dilution of ground water, etc.

Ground disposal at Hanford over 10 years of more than 10^9 l. of active waste

solution containing about half a million curies of fission products have been treated at a cost of about 10 cents/gal. (£7/cu. m.). At Oak Ridge, utilisation of ion-exchange capacity of the soil has cost about 2 cents/gal. (£1.5/cu. m.) compared with 50 cents to $2.00/gal. (£35-£140/cu. m.) for mild steel or stainless steel storage.

TABLE II

Disposal Costs per gallon of Raffinate

	cost (£/cu.m.)
Disposal to unlined ground pits—e.g. ORNL	1.5
Disposal to crates as at Hanford	7.
Disposal as sludge to tanks—e.g. Windscale	1—1.5
Evaporation of highly active waste	10—15
Storage of neutralised highly active waste concs. in underground shielded mild steel tanks	60
Storage of acid highly active waste conc. in underground shield stainless steel tanks	1.00

For low activity effluent, final disposal is the same in principle at all installations, namely, discharge to the sea or suitable river. Discharge may be preceded by treatment, chemical at Windscale and Marcoule and ground disposal in the US.

The need for investigation of each projected locality is stressed, as also the need for continuous monitoring of all likely causes of hazard to ensure the maintenance of complete control at all times.

In conclusion, Mr. Saddington said that for the future improvements to or radical alterations in existing techniques will be required. In the UK, current work is being directed towards a separation process which will give such complete removal of fission products at the first stage that subsequent raffinates have negligible activity. Longer term work in the UK and US is being directed towards high temperature separation processes in which fission products are at all times in a solid and hence compact form.

Chemistry of Fuel Processing in Homogeneous Aqueous Reactors

RELEVANT features of the homogeneous aqueous reactor and special processing problems were the subject of the paper by I. Wells and E. Lofthouse ('Fuel processing in homogeneous aqueous reactors'). The authors said that they believed that it was possible to design such a reactor so that more fissile material was produced than was consumed. In order to do this, it was stressed, it was essential to keep to a minimum the wasteful absorption of neutrons in extraneous atoms. For this reason, together with the need for chemical stability under radiation, the number of chemical compounds, suitable as fissile and fertile materials was stated to be limited.

Reference was made briefly to processing a two-zone breeder reactor, using a core solution of uranyl sulphate and a slurry blanket of thoria in heavy water. With regard to the core circuit, Wells and Lofthouse described gas-liquid processing, solid-liquid separation, a scalping cyclone, a solid separation cyclone, chemical processing, solvent extraction, and the uranium peroxide precipitation process.

The function of the chemical processing circuit is to remove soluble corrosion and fission products for these become important due to two effects: (a) Slow accumulation of soluble neutron poisons and (b) the effects of these soluble materials on the solubilities of uranium in solution.

It was pointed out that nickel was known to form complexes with the uranium which were only sparingly soluble under reactor operating conditions.

Because the fluid used in the reactor system was heavy water it could be advantageous to carry out any chemical processing in the same fluid. A peroxide precipitation process was being developed for this purpose. Alternatively, the heavy water could be removed by evaporation and recovered (*Nuclear Science and Engineering*, 1957, **2**, 664), the sulphate residue redissolved in light water and the uranium purified by solvent extraction, using e.g. tertiary amine tri-*n*-octylamine. Alternatively, the dry uranium residue could be added to the dried thoria from the 'blanket' and processed in plant external to the reactor by a conventional tributyl phosphate solvent.

It would be necessary, it was stated, to add U^{233} (300g.) to the core circuit to replace the U^{233} removed with the core solution plus 200g. to replace that removed for solvent extraction processing.

The uranium peroxide precipitation process could treat solution withdrawn via the cyclone units in a heavy water system. However, it produced an effluent containing significant amounts of uranium, which could be recovered in the solvent extraction plant that is required to process the 'blanket' fluid.

This process has been investigated in the laboratory on the 50 and 1000ml. scale. The influence of excess peroxide, rate of addition, and of pH on the yield and settling rates of uranium peroxide had been examined and it had been shown that over 99 per cent recovery of uranium with a settling rate greater than 0.5 cm./min. could be obtained with 100 per cent excess peroxide and control of pH between 2.5 and 3. Also, over 90 per cent of all contaminants and over 97 per cent of most, could be removed. The efficiency of the removal could be increased further by washing the uranium peroxide precipitate.

Some catalytic decomposition of hydrogen peroxide occurred, the most effective catalyst being ruthenium. Tolerance limits for ruthenium were 10 to 20 p.p.m.

It was found that re-solution of uranium peroxide could be accomplished by boiling with dilute acid or by passing sulphur dioxide into a suspension at room temperature.

Reagents required for this process were heavy water and deuterium sulphate. The use of sodium peroxide introduced sodium into the core solution which was undesirable from the point of view of neutron economy. Chlorine would be required to be kept low to avoid corrosion in the stainless steel system. Washing the peroxide precipitate should reduce the concentrations of both sodium and chlorine to acceptable levels.

Dealing with the 'blanket' circuit, it was stated that the thoria in the heavy water slurry circulating in the blanket absorbed neutrons and eventually produces U^{233}.

$$Th^{232} \xrightarrow{n} Th^{233} \longrightarrow Pa^{233} \xrightarrow{27.4\ \text{days}} U^{233}$$

It had been suggested that solids removed from the core by the cyclones together with some core solution could be processed together with the thoria. These were batched and dried together then removed and fed to the external processing circuit. Conventional solvent extraction methods can be used in the processing plant to separate the U^{233}, Pa^{233}, thorium and fission products. The dry material, including that from core was dissolved in nitric acid containing ammonium fluoride and the Pa^{233} was absorbed on manganese dioxide. The U^{233} is first extracted from the nitric-fluoride solution by 5 per cent tributyl phosphate in a paraffinic diluent and the thorium removed later by 40 per cent tributyl phosphate. After six months the Pa^{233} decays to U^{233} and can be redissolved in acid and fed to the solvent extraction cycle. U^{233} nitrate recovered from the solvent was dried, calcined to uranium trioxide and converted to uranyl sulphate with 'deuterated' sulphuric acid. The recovered thorium nitrate is converted to oxalate, dried and calcined to thorium dioxide.

In processing a single zone suspension system, Wells and Lofthouse reported that the poison level could be controlled by removal of the solid to an external processing plant. Studies were under way, it was stated, on a slurry reactor, having as fuel, uranium oxide in water at a pH about 7. By keeping the oxide particle size between about 5 and 10μ it was believed that only about 10 per cent of the fission products should remain in the particles in a slurry. However, at high temperatures, the lanthanides are strongly bound to oxide surfaces. A recent report suggested using a second solid phase such as activated charcoal (concentration of 2g./kg. uranium oxide) with removal of about 90 per cent of the lanthanides.

Silver Jubilee Symposium

Plastics and polymer group of the Society of Chemical Industry hold their silver jubilee symposium this year. It will be at the William Beveridge Hall of Senate House, University of London, WC1, from 15–17 April. Registration fee for members of the society is £1 10s, and for non-members, £4.

GROWTH OF FOREIGN INVESTMENT IN CANADIAN CHEMICAL PLANT

Smaller US Firms Also Participate

As significant as the virility of the chemical industry in Canada, is the high proportion of external capital injected annually into its veins. The last few years have witnessed an intensification of these injections: the smaller US firms have joined their bigger brothers in building facilities north of the border. Such familiar American names as Hooker, Ethyl, Davison, Borden, Emery and Commercial Solvents were added to the roster of producing companies in 1957. Pennsalt and Witco will join them in 1958.

The influx of foreign investment in chemicals evokes little surprise. The country's contiguity with the industrial giant to the south and her traditional links with the UK were bound to be reflected in the movement of capital into a less developed economy. It is, however, the dimensions of this penetration that has caused certain Canadian misgivings, which were best expressed in the report of the Royal Commission on Canada's Economic Prospects and the official shibboleths of the new Conservative administration.

Statistics Compared

A comparison of available statistics for 1954 and the current investment picture illustrates the source of this concern. At the end of 1953 over 54 per cent of all capital in the industry was invested by firms owned or controlled in the US. By the close of 1957 that percentage had risen to 64. Similarly, the share of other non-domestic investments—mainly British—has risen 2 per cent in the same four years to account for a fifth of the total capital.

If the investment pattern in 1956 and 1957 is any indication, the trend will continue. Fully two-thirds of the estimated $135 million pumped into new construction and equipment in 1957 were from US companies. And while capital spending will diminish to a figure closer to $85 million in 1958, the composition should remain roughly the same.

Union Carbide Canada put their $25 million petrochemical plant in Montreal East on stream last May. Dow Canada completed additional ethylene and glycols units at Sarnia. Du Pont of Canada went into full production of Orlon at Maitland, Ontario, and explosives at North Bay, Ontario. Work is also proceeding on extending facilities for nylon and its intermediates.

Imperial Oil, a subsidiary of Standard Oil of New Jersey, spent $20 million at Sarnia in 1957 in their bid as a chemical producer. A detergent alkylate plant, a Canadian first, was ready in November and a petrochemical plant processing ethylene, butylene and butadiene should go on stream by mid 1958.

North American Cyanamid are constructing Canada's first urea plant at Hamilton, Ontario. Hooker Chemicals have beaten competitors on the west coast with erection of a 100 tons/day chlorine and caustic soda plant north of Vancouver. B. F. Goodrich, the tyre producer, brought in a Geon polyvinyl chlorine plant at Port Robinson, near Niagara Falls.

At Valleyfield, Quebec, Nichols Chemicals, owned by Allied Chemicals, built a hydrofluoric acid plant and Davison, a W. R. Grace affiliate, began shipments in July of petroleum cracking catalyst from their $6 million plant. Further down the St. Lawrence River at Varennes, US National Lead's subsidiary, Canadian Titanium Pigments Ltd., officially opened a $15 million titanium oxide plant.

Monsanto Canada, Standard Chemical (now a subsidiary of Columbia Southern), Brunner Mond (Allied Chemicals) and Canadian Chemicals (established by Celanese Corporation of America) concentrated on expanding existing capacities.

Of the twenty-odd holders of withdrawal permits on Saskatchewan's fabulous potash deposits, the most advanced in production are US companies. Potash Co. of America have a refinery under construction at Lake Patience and International Mineral and Chemical Corp. are sinking a shaft at Yarbo.

European-owned and controlled companies were also active in 1957. Canadian Industries Ltd., whose major shareholder is ICI, put the finishing touches on their $9 million ammonia (Millhaven, Ontario) and hydrogen peroxide (Hamilton) plants. Sulphuric acid units are almost ready at Copper Cliff, Ontario and Beloeil, Quebec and the paint works extended at Toronto. CIL have announced plans to double capacity of their polythene plant in Western Canada.

Electric Reduction of Canada have also pursued a bold expansion programme, particularly in sodium chlorate which is in high demand in pulp and paper and uranium mining. Hardly had their Vancouver plant gone into production, when Electric Reduction started on the construction of equivalent plant in Eastern Canada. In the meantime work is in progress on the facilities for phosphoric acid at a new site off Lake Erie.

Shell Oil are hurrying completion of a detergent alkylate plant in Montreal and will be the first company in Canada to produce epoxy resins.

The totally domestic ventures include a caustic soda-chlorine plant at Shawinigan Falls by Shawinigan Chemicals, and at Sarnia a specialty latex unit by the Crown-owned Polymer Corporation and a Udex unit for aromatic solvents by Canadian Oil.

Canadians, while they may feel uneasy about the dominance of the foreign investor, do not expect to see a major shift in ownership. Nine of the dozen top chemical concerns, and a similar proportion of the first 65 companies, owe their existence to outside capital. But there is pressure for a complete revision in the branch-plant outlook of many non-domestic parent companies.

Six-Point Programme

Thus Finance Minister Fleming listed a six-point programme of proper behaviour for incoming foreign firms. In a recent speech to the US Investment Bankers Association he asked that large US corporations desist from: denying to Canadians any opportunity whatsoever of participating in the ownership of stock in such companies; preventing their Canadian subsidiaries from taking export business; controlling the purchasing policies of the Canadian subsidiary in a manner which consciously diverts its buying away from Canadian sources; failing to train Canadians for advancement to executive status; discouraging Canadian subsidiaries unnecessarily from engaging in research; and failing to bear their fair share of community philanthropies.

An examination of the record and status of Canadian chemical companies that are subsidiaries would show that they are less guilty than others of these malpractices. Most of them have acquired Canadian executive leadership, launched significant research projects and do purchase Canadian materials where possible. Some, like CIL, Du Pont, Canadian Chemicals and Imperial Oil, have seen their way clear to offer equity to Canadian investors.

Direct investment by foreign companies in Canadian manufacturing was conditioned by the latter's need for both money and technical know-how. A pattern was developed early in the century: a market was developed in Canada by means of imports and continental advertising. When

Table I

Estimated Investment in Canadian Chemical Processing Industries

	Chemicals 1953	Chemicals 1957(1)	Petroleum refining 1953	Pulp and paper 1953	Rubber 1953
Estimated total investment ($ million)	572	850	868	1,285	130
Percentage of capital owned in:					
United States	46%	57%	53%	42%	75%(2)
United Kingdom	13%	15%	1%	10%	n.a.
All foreign countries	61%	73%	57%	52%	75%
Percentage of capital controlled in:					
United States	54%	64%	71%	42%	n.a.
All foreign countries	72%	84%	75%	55%	92%

NOTES: (1) The 1957 figures for chemicals are unofficial estimates based on the major investments made in the last four years and on a 5% amortisation rate.

(2) To avoid disclosures about individual firms, The Dominion Bureau of Statistics, who issued the 1953 figures, included British investments in Canadian rubber manufacturing with US investments (which, of course, are by far the majority)

sales were sufficient to warrant domestic production, a branch plant was established.

Du Pont, Cyanamid, Nobel, Nichols, Brunner Mond, Bakelite, Electric Reduction and Courtaulds were the earliest to enter Canada. Monsanto, Dow and Naugatuck joined them during the last war or immediately afterwards. But it was in the last decade, as the Canadian economy moved into high gear, that the majority of US-owned companies—from Cabot Carbon to Rohm and Haas—were established.

The stiffening of world competition in chemicals is spurring the bigger firms to get into the Canadian market a step ahead of a competitor. Whereas once many years would elapse before a new product which had been commercialised in the US or Britain was produced in Canada, today the time differential is much smaller. Low-pressure polythene had hardly become a fact in the US, when Du Pont of Canada purchased a plant site in Sarnia to begin their synthesis there.

Another example: for many years Hooker and Pennsalt supplied British Columbia pulp mills with chlorine and caustic soda from their plants on the US west coast. Now that Hooker have built facilities at Vancouver, Pennsalt have decided to follow suit, purchasing property in the western part of the province.

Yet the chemical manufacturer, be he from the US, the UK or elsewhere, cannot remain unperturbed by the depth of popular feeling in Canada on the subject of subsidiaries. His desire to obtain as big a chunk of the Canadian market as possible will compel him to listen very closely to the advice of Mr. Fleming.

Main Focus of Analytical Chemistry Now on Needs of Industry

DURING 1957, the rapid advances made in science had had their effect on analytical chemistry and on the Society for Analytical Chemistry. This was stated by Dr. Magnus Pyke (Distillers Co. Ltd., Menstrie, Clackmannanshire), chairman at the annual meeting of the Scottish section, SAC, held in Glasgow on 24 January. For election of officers see People in the News, page 243.

Dr. Pyke said that the overwhelming success of the congress on analytical chemistry in industry organised by the section at St. Andrews in June (reported in two special issues of CHEMICAL AGE, 29 June and 6 July) was an outward and visible sign that the main focus of analytical chemistry was now on the manifold needs of industry rather than where it was earlier in the century, namely, on the prevention of adulteration and protection of the public health. Analytical chemistry now covered much more than conventional operations previously carried out in the so-called chemical laboratory.

'If our own society is not ready to deal with the newer aspects of analysis, other organisations are', declared Dr. Pyke. 'For example enthusiasts in the Institute of Petroleum, the Institute of Physics and elsewhere had been singularly successful in forwarding some of the newer methods of analysis.

'The same changes and developments are apparent in the publication of knowledge about analysis and at the present moment we are now witnessing the birth of a new international journal of analytical chemistry to be published by Pergamon Press. All these changes and advances are a challenge to us as analysts and also as members of the Society for Analytical Chemistry. We in the Scottish section must do our part in meeting this challenge in the year lying ahead.'

Information Scientists Form Institute

SUBJECT to ratification, a new professional body has been formed which is to be known as the Institute of Information Scientists. A meeting to discuss the new body was held on 23 January, with Dr. G. Malcolm Dyson in the chair. Opening speeches were made by Mr. J. Farradane (Tate and Lyle Ltd.) and Mr. C. W. Hanson (of the British Scientific Instrument research).

The motion 'That a professional body be, and is hereby, set up to promote and maintain high standards in scientific and technical information work and to establish qualifications for those engaged in the profession' was discussed and was approved by 75 votes to 4. Letters supporting the motion were received from 25 persons replying by letter.

A temporary working committee of ten with power to co-opt two was approved for the purpose of devising a draft constitution of the Institute. Members of the working committee are Dr. Dyson, Mr. Farradane, Mr. Gordon Foster (Furniture Development Council), Mr. Hanson, Mr. Holloway (Ministry of Supply), Mr. Liebesny (Mond Nickel Co.), Mr. Paton (Metropolitan Vickers Electrical), Mr. Reed, (DSIR), Mr. Sewell (United Steel Cos. Ltd.), and Mr. Snow (Fisons Pest Control Ltd.). Further details may be obtained from Mr. J. Farradane, 'Torran,' Crofton Road, Orpington, Kent.

Ruabon Gets Good Housekeeping Prize

The Ruabon works of Monsanto Chemicals Ltd. have won the company's good housekeeping competition, beating Newport by a small margin. Sir Miles Thomas, chairman of Monsanto, presented a cup to Mr. E. V. Weeks, works manager.

New Paint Dryers Claimed in USSR

VINYL ESTERS of fatty acids copolymerised with tung oil or other unsaturated compounds are claimed to produce high drying qualities in paints, and to be capable of replacing oil paints. The work is described by V. V. Korshak and co-workers in *Zh. Prikladn. Khim.* (J. Appl. Chem.), 1957 **30**(9), 1368-74, as a continuation of their studies in the synthesis of high molecular compounds during the past ten years. A mixture of the fatty acids, first oleic and then cottonseed oil f.a., with zinc oxide (about 2 per cent) was treated in an autoclave with acetylene under a pressure of 15 to 17 atm. and temperature of 176°C for 11½ hours. The vinyl oleate obtained was polymerised in the presence of benzoyl peroxide. Results are tabulated for temperatures of 100°C, 150°C, 200°C, 250°C and 275°C with and without initiator, and for varying periods of two to eight hours (or 32 hours in some cases of 100°C temperature). Vinyl esters of fatty acids usually show a marked tendency to split or hydrolyse at high temperatures.

Further tests were made with cottonseed oil f.a. and the product (85 per cent) copolymerised with tung oil (15 per cent) under conditions as described, whereby lower temperatures were possible. In order to determine drying and other properties the copolymer was additioned with 90 per cent white spirit and 5 per cent dryer No. 7640, and a paint prepared therefrom with iron ochre (iron minium). Drying and other characteristics compared very well with those of paints prepared with the usual natural dryers.

End-point of Silver Nitrate Titrations

IN a note to *The Analyst* (1958, **83**, (January), 55) W. F. N. Leitch and F. A. Lewis of the department of chemistry, Queen's University of Belfast, report that when solutions of sodium or potassium chloride are titrated with silver nitrate, with dichloro fluorescein as indicator, observation of the character of the precipitate gives a more accurate and clear-cut end-point. At the end-point the precipitate breaks down and becomes finely divided and granular in appearance. It is stated that with 0.1 M solutions, this end-point gives reproducible results in agreement with those obtained by the Mohr method corrected for a blank.

When solutions of sodium or potassium bromide, iodide or thiocyanate are titrated in the siver nitrate, no comparable reproducible change in the character of the precipitate occurs, Leitch and Lewis observe.

Unilever Gift to Manchester College

The board of Unilever Ltd. have given the sum of £21,000, under a seven-year Deed of Covenant, to the Manchester College of Science and Technology. Of this sum £2,000 is to be allocated to the staff college, and the balance will be divided equally between the chemistry and chemical engineering departments.

Overseas News

PROPOSED NORDIC COMMON MARKET WILL INCLUDE CHEMICALS

A COMMON market between Denmark, Finland, Norway and Sweden is proposed in a report of the Committee for Nordic Economic Co-operation. Chemicals are included in the list of products that would be covered, as well as most industrial raw materials.

A common Nordic tariff would be applied to the range of goods included within the market which originate from any foreign country. The level of this common external tariff would be no higher than the average of the levels now ruling in the four countries. Quantitative restrictions on imports falling within the common market and originating from member countries would be mutually abolished. The contracting countries, however, would be permitted to retain their restrictions against the imports from countries outside the common market.

No export quantitative restrictions would be applied to exports to other contracting countries. If such restrictions were imposed the contracting countries would be required to consult with each other in order to prevent the abuse of re-exports from themselves to outside countries.

Fuller details of the proposed Nordic common market may be obtained from the Export Services Branch of the Board of Trade.

Another Dimethylterephthalate Plant for Du Pont

Du Pont are to build another dimethylterephthalate plant at Old Hickory, Tennessee. Preliminary construction is to begin immediately and the plant is scheduled for completion in 1959. Plant capacity is not known but the new unit is expected to employ about 100 people. DMT is used in producing Dacron, polyester fibre, polyester film and polyester photographic film base.

Du Pont officials are also considering the building of a Dacron plant at Old Hickory.

Australian Explosives Factory Planned

A £A3 million plant for the manufacture of commercial explosives is to be built by Nobel Australasia Pty. on a 2,000-acre site at Bass Point, seven miles south of Sydney. Work on the erection of the plant is expected to begin soon.

Witco to Make Phthalic Anhydride in Chicago

Plans for the construction of a phthalic anhydride plant in Chicago have been announced by the Witco Chemical Co., New York, US. The plant will be designed and constructed for Witco by the Scientific Design Co. Inc., of New York City, and will be located in Chicago's Clearing district, adjacent to one of Witco's present chemical manufacturing plants. Completion date of the new plant has been scheduled for early 1959. It will have an annual capacity of 20 million lb. of high-quality phthalic anhydride. The new product will be sold through Witco's Organic Chemicals Division, which also markets their stearates, driers, and plasticisers.

New Premises for Bayer's Italian Agents

CO-FA, who are exclusive Italian agents of Farbenfabriken Bayer of Leverkusen, have moved into a new building at No. 126 Viale Certosa, Milan, which also houses the offices of AGFA (photographic products) and EMAILS (specialised in manufacture of enamels).

Bayer's range comprises about 13,000 items, of which 6,000 are dyestuffs and ancillary products, 3,700 chemical products and about 200 intermediary products for textile industry.

Nitrogen as Aerosol Propellant

Aerosol Techniques Inc., Bridgeport, Connecticut, US, have, for the first time, produced nitrogen-propelled aerosols. Due to inertness of nitrogen, stated to act as an invisible internal piston, delivery of the product is obtained without physical disturbances by the gas. Also, nitrogen propellant is much less expensive than conventional propellants. First products in the nitrogen-propelled aerosol package will be toothpaste, cleansing cream and hair cream.

New Plant for Synthetic Rubber

Shell Pernis Chemische Fabrieken NV are to build a synthetic-rubber factory at Pernis, near Rotterdam, in Holland. The new plant will have an initial capacity of about 50,000 tons a year.

L-Monosodium Glutamate Synthesis

Reports from the US indicate that the total synthesis of l-monosodium glutamate may be on a commercial scale soon. Du Pont report that they have a more economical total synthesis process and that engineering investigations are being carried out. International Minerals, who announced last October that they had developed a process, now report that they have reached the pilot plant stage.

Salt Water Distilling Machine

An Australian engineer, Mr. R. Brunt, of Neutral Bay, Sydney, has invented a distilling machine which is said to produce 1,000 gallons of fresh water from salt water each day. A demonstration model, made largely from old piping and petrol drums, has produced 50 to 60 gallons a day.

Sun's rays are concentrated under an area of glass, 6 feet by 3 feet. The convex aluminium lining of the tank reflects the rays and heats to 95 degrees the salt water, which runs through black serpentine pipes. When heated, the water is stored in a hot water tank, then sucked into a vacuum in an evaporator where it boils. Steam produced is sent through a condenser, and comes out as pure water. Impurities are drained from the evaporator through another pipe.

Lithium for Boron Missile Fuel

Lithium Corporation of America have met more than 90 per cent of Olin Mathieson Chemical Corporation's requirements for lithium used to date in high energy fuel production. Orders in hand indicate that Lithium Corporation would supply a similar proportion of Olin Mathieson's requirements in 1958. This company has major contracts with the Air Force and Navy to supply high energy chemical fuels for missiles and aircraft and lithium is a principal intermediate in the manufacture of boron-based chemical fuels. Amounts of lithium involved are not released.

Phosphoric Acid Project Planned by ERC of Canada

Plans are being advanced by Electric Reduction Co. of Canada Ltd. for the construction of a new plant to produce phosphoric acid as well as sodium and calcium phosphates. The new plant will be on a 200-acre site at Port Maitland, Ontario.

Fertiliser Factory for Sylhet

A team of Japanese experts is expected before the end of this month to undertake construction work of a proposed fertiliser factory at Fenchuganj in the Sylhet district, Pakistan. An agreement has been entered into by the Pakistan Industrial Development Commission and a Japanese company. Preliminary work at the site of the factory has been started by a PIDC advance party. The proposed factory will produce 250,000 tons of standard fertiliser and will cost over Rs 150 million.

New German Process for Heavy Water

Small scale trials of a new process to produce heavy water are being carried out by Professor Erinien W. Becker, of Marburg University in Germany. It is understood that a liquid-phase exchange of deuterium between hydrogen and water is catalysed. Details of the catalyst em-

ployed and the conditions required have not been revealed. Tests, however, have been encouraging enough to warrant plans being made for the installation of the pilot equipment used at Marburg in the isotope research laboratory planned for the German reactor at Karlsruhe.

Synthetic Rubber Works for Holland

A synthetic rubber factory is to be erected in the Netherlands by NV De Bataafsche Petroleum Mij. The new factory, which will produce butadiene-styrene type rubber, will be located at Pernis, near Rotterdam, and will have initially a productive capacity of at least 50,000 tons per annum. Pernis, which since the war has become an important chemical manufacturing centre, is favourably located for the supply of raw materials and for the shipment of end products.

New Drug for Bilharzia

Internationally known authority on bilharzia, Dr. William Alves of the Research Laboratory in Salisbury, Rhodesia, reports that antimony dimercaptosuccinate (TWSB) discovered by Dr. E. A. H. Friedheim of New York, US, has been used successfully in the treatment of 25 cases of bilharzia. Dr. Alves' trial of TWSB is being reported in the forthcoming issue of the Central African journal of medicine.

The drug is stated by Dr. Alves to be 'the best at present available for chemical use in urinary bilharziasis.' It is administered by injection. No symptoms have been noted in treatment.

Rise in US Chemical Prices

Figures released by the US Department of Labour indicate that the December 1957 index for chemicals and allied products has risen by 0.2 per cent from the previous month and is 2 per cent up over the previous year. The largest monthly rise is shown by prepared paint and industrial chemicals. Compared with the 1947-49 average, however, this group is only 10.5 per cent up, compared with the 26 per cent rise for all commodities except farm products and foods.

Belgian Exports to UK

The latest available figures of sales of Belgian chemicals to the UK show that in August last year chemicals worth £385,000 were sold. This is the lowest monthly figure since January, 1956.

German Titanium Dioxide Plant

Farbenfabriken Bayer AG have opened a new titanium dioxide plant at Urdingen, near Krefeld, in Germany. An initial output of 15,000 tons a year will later be raised to 50,000 tons. About 500 workers will be employed when the plant is in full production.

New Philippine Chemical Company

Philippine Industrial Explosives Co. Inc., 502-506 Samanillo Building, Manila, has been formed, with an authorised capital of 1 million pesos (approx. £180,000) to produce nitroglycerine, dynamite, gun cotton, etc. The company also plan later on to produce fertilisers, plastics, insecticides, drugs, sulphuric and hydrochloric acid and other chemicals.

New Route to Ethyl Alcohol

According to a Tass report, the Petroleum Institute of the USSR Academy of Sciences has developed a method of producing ethyl alcohol from hydrogen and carbon dioxide. By means of catalysis, a cubic metre of the starting material yields up to 90 grammes of ethyl alcohol, together with methyl alcohol butyl and propyl alcohols, acetic acid and other products.

98% Ethylene Diamine Available from Olin Mathieson

Desire for a more concentrated product by many US ethylene diamine consumers has resulted in the addition of the 98 per cent material to the organic chemicals division's range of Olin Mathieson Chemical Corporation. The 85-88 per cent and 90-93 per cent of ethylene diamine will still be produced. There will be no change in the availability of polyamines 333 and 910.

Fertiliser Expansion in China

Expansion of the chemical fertiliser plant in Dairen, China, has begun in an attempt to treble its annual output to 800,000 tons. The joint state private Yung-li chemical works in Nanking is being extended to yield an additional 80,000 tons of ammonium sulphate annually. A new ammonium sulphate plant is to be added to these works, equipped with Czechoslovak machinery.

Vanillin from Pulp Sulphite Liquor

An improved process for making vanillin from waste sulphite liquor in pulp or cellulose production is reported by Aschaffenburger Zellstoffmerk, Aschaffenburg, West Germany. Alkaline sulphite liquor is neutralised with waste carbon dioxide and mixed sodium, potassium and magnesium chlorides. This precipitates lignin derivatives (mainly aromatic alcohols and terpenes) which would otherwise hinder extraction of vanillin in neutral solution. Following oxidation with air under pressure, the vanillin is extracted from neutral solution by ion-exchange and purified with steam distillation. A yield of about 18.2 per cent vanillin is obtained based on lignin content.

Synthetic Rubber Materials Exempted from Italian Duty

The following products required for use in the production of synthetic rubber have been exempted from customs duty by the Italian Government: divinyl benzene; aromatic extracts; *tert*-butylcatechol; triethylenetetramine; lecithin; sodium ethylenediaminetetra-acetate; sodium dimethyldithiocarbamate; *n*-dodecane-l-thiol and *tert*-dodecyl mercaptan; menthane hydroperoxide; distilled tall oil; methylenedinaphthalenesulphonic acid; antioxidants of the following kinds: alkylated aryl phosphites, alkylated phenols, or products of the reaction between diphenylamine and acetone; potassium soap of resin acids; sodium salts of tall oil fatty acids; potassium soap of fatty acids; sodium soap of fatty acids.

Montecatini to Survey Israel's Phosphate Deposits

It is reported from Tel Aviv that the Montecatini combine has been given a contract to survey Israel's phosphate deposits with the Israel Government, and to carry out the resultant exploitation jointly. British and German companies are also believed to be investigating phosphate fields with a view to sharing in the exploitation.

To date 18 fields have been discovered. The one field being exploited produces 250,000 tons of phosphate annually.

The director of the Dead Sea Works, the company which operates the Sodom potash plant, is to visit Germany to hasten the delivery of equipment ordered for Sodom. He will also visit the Ebasco Corporation, New York, to discuss the execution of a survey by Ebasco to increase potash production, now running at nearly 100,000 tons a year.

US Work on Aluminium Silicate Gel for Radioactive Wastes

PRELIMINARY studies by research chemists at General Electric, US, indicate that an aluminium silicate gel can take up by occlusion and reaction caesium 137 and strontium 90 and then be blown as a 'custard-like' mass into a disposal pit.

The method suggested is that a step be added in the recovery process. Thus to the liquors obtained after separation of uranium and plutonium, which contain aluminium (from fuel element cladding) caesium 137, strontium 90 and other fission products, sodium silicate is added in a pipe-line-type reactor. Aluminium sodium silicate forms as a gel and is discharged to the disposal pit.

It has been found that the gel on ageing deteriorates and bleeds water. This water has been shown to contain some radioactive caesium or strontium. The application of heat to the gel has been examined. Heat generated by radiation also can turn the gel into a clay-like substance. At higher temperatures this clay melts and on cooling, yields a porcelain-like material. Over 1,000°C a glass forms from the gel. Whether these materials will resist the leaching of the radioactive elements by water is not known.

The gel technique, if successful, GE reports, would halve present costs, since the tank system could be eliminated. The gelled waste would only require to be buried.

PEOPLE in the news

● Colleagues of ALDERMAN KENNETH WILSON, chairman of Albright and Wilson Ltd., paid tribute to him on 22 January, the anniversary of his 50 years with the company. During a dinner at the company's Oldbury Works, Mr. and Mrs. Wilson were presented with the painting, 'Derwentwater' by W. Havell, subscribed for by the employees of Albright and Wilson and subsidiary companies. The occasion also marked the retirement of Mr. Wilson, who on 23 January became president of the company. MR. R. E. THREFALL, director, presented the gift. Reference to Mr. Wilson's work as an alderman of the borough and of Worcestershire County Council was made by COUNCILLOR A. GUNN and a toast to 'Mr. Kenneth' was proposed by the chief buyer, MR. ARTHUR WEBB, who joined the company in 1917.

● MR. D. C. F. DEVOS, managing director of Courtaulds' chemicals division, who retired on 31 December 1957, was with the company for 38 years, most of which were devoted to Courtaulds' chemical and viscose rayon manufacturing activities. He started at their Trafford Park sulphuric acid and carbon disulphide works in 1920 shortly after it was first opened. In the 1930's, after six years as general manager of Courtaulds' French company, Les Files de Calais, Mr. Devos was responsible for the design of new viscose rayon processing equipment. Since the war he played a leading part in the further development of Courtaulds' sulphuric acid and carbon disulphide manufacturing activities. He was also a director of the United Sulphuric Acid Corp., the British Sulphur Corp. and the Sulphur Exploration Syndicate. He served too for many years on the council and various committees of the National Sulphuric Acid Association.

D. C. F. Devos

● LORD GLENCONNER has been appointed chairman of the Union Oxide and Chemical Co. He succeeds Mr. E. W. D. Tennant, who remains on the board. Mr. R. S. Ford has been appointed a director.

● British Oxygen Co., have appointed MR. A. D. SMART finance manager. He is succeeded as secretary of the company by MR. B. R. D. CLARK.

● MR. W. CARTER has been made a director of Albright and Wilson Ltd. Mr. Carter joined the company in 1940 and was appointed the first managing director of the operating company, Albright and Wilson (Mfg.), on its formation last year.

● MR. MALCOLM GEORGE GELL, an employee of Bleasdale Ltd., manufacturing chemists of York, has obtained first place in the final examinations of the City and Guilds of London Institute in chemical plant operation, 1957. He has been awarded the institute's silver medal, and presented by the Association of Chemical and Allied Employers with a gold watch, in recognition of this distinction. After a successful period as a part-time student in the intermediate course at York Technical College, Mr. Gell pursued his final studies in the short sandwich course at the West Ham College of Technology, London. The West Ham sandwich scheme is conducted over two periods of full-time study, each of ten weeks' duration, held in consecutive years; the first period runs from May to July, immediately after the results of the intermediate examinations are published; and the second period from the following February to April. During the intervening works' period, contact is maintained with the college through a system of home exercises. Of the four students in the course, two gained first-class passes and one a second-class pass, a result said to be well above the average for the country.

● Fisons Ltd. have appointed DR. W. G. HUMPHREY, at present headmaster of The Leys School, Cambridge, to be their group personnel officer. Dr. Humphrey took first class Honours in the School of Chemistry, Oxford, and became Ph.D. in 1928. He then moved to Harvard University as a Commonwealth Fund Fellow and did research in organic chemistry under DR. J. B. CONANT. Dr. Humphrey has served on the Cambridgeshire Education Committee and the Council of the Public School Appointments Bureau. He will take up his new appointment in May.

● MR. F. GRAUCOB, managing director of Nu-Swift Ltd., has arrived in this country from a tour of continental markets. His trip was part of the 1958 export drive which began in October when MR. H. G. STAGE, Nu-Swift's overseas marketing manager, left on a visit to Africa, from which he has not yet returned. Nu-Swift's exports in 1957 exceeded £250,000.

● MR. G. MCCUTCHEON has been appointed works superintendent at the Gateshead factory of Quasi-Arc Ltd. Joining the staff at the factory in 1947, Mr. McCutcheon became chargehand of the machine shop the following year, and machine shop foreman in 1956.

● MR. A. F. APPLETON, formerly head of the electronics and vibration laboratory of Bristol Aircraft Ltd., Filton, Bristol, has now taken up an appointment as chief engineer with Benson-Lehner (G.B.) Ltd., (specialising in applied cybernetics), 12 Bargate, Southampton.

● MR. S. DIXON, a public analyst, was elected chairman of the western section of the Society of Analytical Chemistry at their recent AGM held in Bristol. DR. G. V. JAMES was elected vice-chairman and DR. T. G. MORRIS hon. secretary and treasurer.

● Cape Asbestos Co. have appointed MR. S. D. H. POLLEN a director.

● Deputy chairman and joint managing director of Turner Newall, MR. H. HANSON, has resigned, due to ill-health. Mr. Hanson joined the organisation over 50 years ago. The new deputy chairman is MR. R. G. SOOTHILL, formerly joint managing director with Mr. Hanson.

● MR. R. J. SOUTHWELL, president of Canadian Resins and Chemicals Ltd., has been appointed vice-president of Carbide Chemicals Co. and also of Bakelite Co. DR. R. S. JANE, president of Shawinigan Chemicals Ltd., has been elected president of Canadian Resins, replacing Mr. Southwell, who remains a director. Mr. Southwell joined Canadian Resins in 1948 as sales manager, following 13 years' association with Union Carbide Corp. in the US.

● MR. M. J. HOWARD, who had been chief accountant to Price's (Bromborough) Ltd. since May last year, has joined the board. Mr. Howard, who qualified as a chartered accountant with Peat Marwick Mitchell and Co., joined Industrial Soaps Ltd. in 1952 as accountant and later as assistant secretary. In 1956 he moved to Silvertown and joined John Knight Ltd. as chief accountant, a post which he held until his move to Bromborough Pool. His place as accountant to Price's (Bromborough) Ltd. has been taken by MR. R. AUDAS.

M. J. Howard

● LORD HAILSHAM, Lord President of the Council, accompanied by DR. H. W. MELVILLE, DSIR secretary, paid an informal visit to the laboratories of the British Cotton Industry Research Association, Shirley Institute, Manchester, on 21 January. During their visit they saw

chemical engineering, including work concerned with the simplification of the ageing process for printed fabrics by the use of the Shirley flash ager, which in many instances produces fabrics of a better quality than those produced conventionally, together with outstanding advances in speed of operation and steam economy.

● SIR JOHN COCKCROFT, director of the Atomic Energy Research Establishment since it was set up in 1946, will under a re-organisation scheme be succeeded in this post on 17 February by the deputy director, DR. B. F. J. SCHONLAND. Sir John will continue as the member of the Atomic Energy Authority for scientific research, a post he has held since 1954, when the AEA was established. Dr. Schonland who served as scientific adviser to Field Marshal Viscount Montgomery from D-Day until the end of the war with Germany, was director of the Bernard Price Institute of Geophysical Research at Johannesburg before taking up his post as AERE deputy director in 1954. MR. W. R. J. COOK, knighted in the New Year Honours, deputy director of the Atomic Weapons Research Establishment, Aldermaston, is to become a full-time member of the authority for a five-year period from 17 February. He will be responsible at board level for policy questions on production and engineering. SIR WILLIAM PENNEY will continue to be member for weapons research and development and pending the appointment of a new director of the AWRE will continue to hold that post also.

Sir John Cockcroft

● Flying to the US for a three-week tour on January 26 were MR. L. W. STUBBS, sales director, Albright and Wilson (Mfg) Ltd., MR. A. H. LOVELESS, technical director, and MR. A. MC. L. AITKEN, technical sales manager, Kanigen department, Albright and Wilson (Mfg). During visits to Chicago, Los Angeles, Sharon (Penn.), Dunkirk (NY), Buffalo and New York, they will have discussions with directors and senior executives of the General American Transportation Corporation, and will visit plants operating the Kanigen process throughout America. Albright and Wilson (Mfg) are sole licensees for the process throughout the UK and Eire, in Denmark and throughout those parts of Africa within the Commonwealth.

● MR. W. E. WRIGHT has retired from the board of the Pyrene Co. Ltd. and from control of the metal finishing division. Starting some 30 years ago with the original Parkerizing process, he and his colleagues did much to make the British engineering industry 'rust-proofing' conscious and under his guidance the Bonderizing range of processes for paint bonding and for facilitating the cold working of metals was introduced into this country. MR. H. F. PARSHALL, who has been on the board since 1947, now takes over board responsibility for the metal finishing division.

● DR. THOMAS RICHARDSON, chief export representative, ICI Ltd., with Mrs. Richardson, sailed from Southampton for New York on 22 January on the *Queen Elizabeth*.

● SIR SOLLY ZUCKERMAN, deputy chairman of the Advisory Council on Scientific Policy and a scientific adviser to the Lord President of the Council, has been appointed UK representative to the science committee of the North Atlantic Treaty Organisation.

● MR. ALAN SMITH, director and works manager of Ashburton Chemical Co. Ltd., was presented with an award for 25 years of service at the annual dinner and dance of the company on 23 January.

● MR. J. N. NUTTAL has been appointed to the board of Lubrizol Great Britain Ltd. He was formerly manager of the West German sales offices, and in his new position will be in charge of sales in the UK. MR. A. E. HOPE, also a director of Lubrizol, has been appointed commercial director and will deal with exports. DR. F. F. MUSGRAVE, formerly commercial managing director, has left the company to take up an executive position with Albright and Wilson Ltd.

● MR. A. BILLINGHAM, technical representative in the Midlands for Megator Pumps and Compressors Ltd., 43 Berkeley Square, London W1, will shortly be taking up an appointment with Megator Pumps and Compressors Inc., Pittsburgh, USA, the newly formed subsidiary which handles the company's American business. Mr. Billingham is succeeded in the Midlands by MR. N. H. MACPHERSON, 72 Wombourn Park, Wombourn, near Wolverhampton.

● Principal officers of the Scottish section, Society for Analytical Chemistry, were re-elected at the annual meeting held in Glasgow on 24 January. DR. MAGNUS PYKE, B.Sc., Ph.D., F.R.I.C., F.R.S.E., (Distillers Co. Ltd., Menstrie), chairman, MR. A. N. HARROW, A.H.-W.C., F.R.I.C. (Bilsland Brothers, Glasgow), vice-chairman, MR. J. A. EGGLESTON, B.Sc. F.R.I.C. (Boots Pure Drug Co., Airdrie), hon. secretary and treasurer, were re-elected. The committee comprises: DR. R. A. CHALMERS (Aberdeen University), H. C. MOIR (Beatties Bakeries Ltd., Glasgow), J. W. MURFIN (Boots Pure Drug Co., Airdrie), DR. D. M. W. ANDERSON (Edinburgh University), R. KERR (ICI Nobel division, Stevenston), and PROFESSOR A. D. WALSH (Queen's College, Dundee); hon. auditors (re-elected) J. ANDREWS and J. MCL. MALCOLM; Ramsay dinner representative, R. KERR. After the meeting, MR. S. A. PRICE (Vitamins Ltd.), hon. secretary of the society, gave a talk on 'Micro-organisms in analytical chemistry', describing their scope, selection, advantages and limitations.

Dr. Magnus Pyke

● Recent changes at Geigy include three appointments to subsidiary and associate companies. MR. J. SMETHURST, sales manager of the pigmentary colours division, has been appointed to the board of James Anderson and Co. (Colours) Ltd., Paisley, a member of the Geigy group; MR. L. R. DOWSETT, sales manager of the plastics chemicals division, has been appointed to the board of Gyl Chemicals Ltd.; and MR. A. HILL, technical manager, plastics chemicals division, has joined the board of the Aliphatic Research Co. Ltd. Gyl Chemicals and Aliphatic Research are associate companies of Geigy Holdings Ltd.

● MR. PHILIP E. HOLDEN, chairman, United Kingdom Chemicals Ltd., arrived at Southampton from New York on 24 January aboard the *Queen Mary*. MR. H. S. HIBBINS, vice chairman, Boots Pure Drug Co. Ltd., Nottingham, and MR. ERNEST A. HARVEY of Boots Pure Drug Co., also arrived on the *Queen Mary*. Sailing a few days earlier for New York on the *Mauretania* was DR. E. E. POCHIN, director of the department of chemical research, University College Hospital Medical School, London.

Obituary

The death has occurred of PROFESSOR ROBERT W. WHYTLAW-GRAY who retired in 1945 from the Chair of Chemistry at Leeds University after 22 years' service as head of the department of chemistry. Professor Whytlaw-Gray was mainly concerned with the investigation of atmospheric pollution. Since 1940 he had been British representative on the committee of atomic weights of the International Union of Chemistry. In 1950 he received an honorary degree of Doctor of Science of the University of Leeds. During the first world war Professor Whytlaw-Gray was civilian adviser to the Chemical Warfare Committee and during the second world war was head of an extra-mural team of scientists who worked on chemical defence and methods of protection in chemical warfare.

MR. FRANK ALBERT KEELING, founder and managing director of Keeling and Walker Ltd., chemical manufacturers, of Stoke-on-Trent, died on 23 January, aged 77.

Will

COLONEL M. C. CLAYTON, D.S.O., O.B.E., director of the Murphy Chemical Co., Hon. Colonel, Cambridgeshire Regiment, who died on 3 November last, aged 65 years, left £16,208 net.

UK Chemical Exports and Imports for 1956 and 1957

EXPORTS		QUANTITY 1956	QUANTITY 1957	VALUE 1956	VALUE 1957
INORGANIC				£	£
Acids	Cwt.	196,166	211,993	642,792	691,482
Copper sulphate	Tons	47,811	28,427	4,911,967	2,460,419
Sodium hydroxide	Cwt.	5,361,603	4,181,814	6,681,246	5,347,592
Sodium carbonate	,,	4,785,261	4,260,594	2,996,436	2,918,116
Aluminium oxide	Tons	26,308	32,725	856,926	1,139,392
Aluminium sulphate	,,	42,136	34,753	602,052	492,073
Other aluminium cpds.	,,	3,658	3,862	169,954	159,185
Ammonia	Cwt.	91,310	79,260	340,393	309,574
Ammonium cpds. (not fertilisers or bromide)	Tons	23,262	18,577	883,668	722,442
Arsenical compounds	,,	4,388	3,724	344,116	266,199
Bismuth compounds	Lb.	322,519	386,460	273,121	317,957
Bleaching powder (chloride of lime)	Cwt.	346,432	250,135	570,397	427,090
Hydrosulphite	,,	81,941	85,988	647,843	671,369
Other bleaching materials	,,	113,044	144,218	509,050	676,969
Calcium compounds	,,	342,761	355,989	693,491	711,865
Carbon blacks	,,	486,732	774,474	1,698,673	2,844,802
Cobalt compounds	,,	13,046	16,810	583,658	589,370
Iron oxides (chemically manufactured)	,,	93,020	95,134	298,943	289,579
Lead compounds	,,	48,739	59,077	326,462	347,398
Magnesium compounds (nes)	Tons	13,796	17,604	716,709	876,641
Nickel salts	Cwt.	79,691	82,654	763,084	904,036
Potassium compounds (not fertilisers or bromides)	,,	57,137	61,637	552,822	601,401
Sodium bicarbonate	,,	734,438	726,550	654,731	667,423
Sodium phosphates	,,	99,374	133,516	435,684	603,618
Sodium silicate (water glass)	,,	413,379	323,728	365,191	290,325
Other sodium cpds.	,,	1,744,394	1,769,144	3,805,159	4,007,152
Tin oxide	,,	7,631	8,603	281,308	310,135
Zinc oxide	Tons	6,183	7,067	485,885	498,356
Inorganic chemicals (nes)		—	—	4,676,074	4,763,584
ORGANIC					
Acids, anhydrides and their salts and esters		—	—	1,330,768	1,358,316
Glycerine	Cwt.	64,997	100,235	679,761	925,052
Ethyl alcohol, etc., and mixtures of alcohols (nes)		—	—	1,360,522	1,586,755
Acetone	Cwt.	187,974	130,003	486,624	410,331
Citric acid	,,	41,703	49,588	408,878	490,956
Gases, compressed, liquid or solid (nes)		—	—	924,233	2,304,172
Phenol	Cwt.	97,940	138,399	633,196	881,953
Salicylates	Lb.	962,591	993,447	246,310	277,813
Sodium compounds	Cwt.	26,660	29,875	312,250	401,113
Sulphonamides, not prepared	Lb.	1,688,633	1,523,626	897,001	1,142,053
Dyestuffs intermediates (nes)	Cwt.	86,033	99,262	1,339,503	1,370,458
Organic compounds (nes)		—	—	13,975,410	16,570,298
Total for elements & cpds.		—	—	**59,362,291**	**62,624,814**
Coal tar	Tons	114,660	89,304	1,079,069	973,062
Cresylic acid	Gall.	3,727,193	3,080,488	1,217,515	1,109,057
Benzol	,,	1,234,104	21,097	204,664	8,735
Creosote oil	,,	24,318,713	18,445,474	1,596,413	1,283,754
Other mineral tars and crude chemicals	Cwt.	250,892	200,250	573,021	449,520
Pigment dyestuffs	,,	23,849	29,512	969,096	1,186,212
Other synthetic dyestuffs	,,	187,223	187,928	8,528,590	9,108,730
Synthetic organic pigments	,,	24,025	25,683	812,941	993,370
Vegetable and animal dyeing extracts	,,	4,467	3,473	132,863	129,525
Tanning extracts (solid or liquid)	,,	110,239	124,519	493,888	556,611
Synthetic tanning materials	,,	73,766	78,313	263,675	298,810
Pigments, paints, varnishes, etc.		—	—	23,508,874	24,181,465
Drugs, medicines, etc.		—	—	35,935,776	39,639,820
Explosives		—	—	10,900,087	10,537,377
Insecticides, fungicides and rodenticides	Cwt.	354,673	345,312	4,162,465	4,240,430
Weedkillers	,,	85,852	87,673	981,785	977,163
Carbons, decolorising or activated	,,	92,998	79,525	402,572	337,871
Tetra-ethyl lead anti-knock compound	Gall.	4,839,560	5,460,524	10,427,284	11,929,524
FERTILISERS					
Ammonium nitrate	Tons	3,786	2,148	122,650	70,703
Ammonium sulphate	,,	24,651	205,804	478,425	3,538,267
Phosphatic and potassic		—	—	71,097	63,056
Other fertilisers		—	—	417,097	411,383
PLASTICS MATERIALS					
Phenol and cresol formaldehyde resins	Cwt.	63,596	72,966	449,707	503,826
Urea formaldehyde resins	,,	270,252	220,769	1,296,539	1,115,507
Vinyl resins, unplasticised	,,	163,745	208,425	1,563,727	1,813,354
Vinyl resins, plasticised	,,	106,517	147,626	1,367,443	1,745,948
Other vinyl resins	,,	183,273	213,519	2,327,682	2,712,168
Moulding powders	,,	796,888	940,007	10,272,019	12,222,848
Sheet, rod, tube, film and foil	,,	270,270	312,360	8,216,803	9,097,431
MISCELLANEOUS					
Photographic chemicals (nes)	Cwt.	34,059	40,008	596,366	690,975
Scientific glassware	,,	17,547	15,818	824,256	841,554
Chemical and gas machinery	,,	118,132	156,571	2,250,878	3,535,026

IMPORTS		QUANTITY 1956	QUANTITY 1957	VALUE 1956	VALUE 1957
INORGANIC				£	£
Acids	Cwt.	61,737	59,732	181,420	185,957
Aluminium oxide—Crude, unground	Tons	22,224	19,868	1,167,574	1,089,802
Ground or graded	,,	2,985	3,200	313,476	350,507
Silicon carbide	,,	11,546	9,539	1,184,713	981,542
Arsenic trioxide	,,	5,551	3,294	191,935	98,193
Borax, refined	Cwt.	465,006	514,540	887,655	1,018,918
Calcium carbide	,,	1,067,670	1,291,439	1,985,652	2,485,320
Carbon blacks, channel	,,	162,372	178,396	900,164	1,026,893
Other carbon blacks	,,	90,205	93,549	342,075	362,537
Cobalt oxides	,,	11,821	7,710	739,575	483,196
Iodine	Lb.	474,605	948,429	236,451	366,048
Mercury	,,	1,486,311	1,380,252	1,627,057	1,526,337
Sodium, calcium, potassium, lithium, etc.	Cwt.	73,254	24,058	1,025,959	199,391
Potassium carbonate	,,	85,422	107,622	278,261	353,305
Other potassium cpds. (not fertilisers)	,,	73,767	94,416	344,987	429,641
Selenium	Lb.	197,188	143,877	1,179,015	695,275
Silicon	Tons	6,016	5,618	910,883	949,109
Sodium chlorate	Cwt.	91,598	108,858	280,407	366,331
Sodium phosphate	,,	21,063	5,875	97,048	33,825
Other sodium cpds.	,,	291,271	333,364	1,101,849	1,206,720
Inorganic chemicals (nes)		—	—	2,704,176	3,029,078
ORGANIC & OTHERS					
Acids, anhydrides and their salts and esters		—	—	1,887,509	2,872,247
Glycerine	Cwt.	98,837	107,566	735,929	659,948
Menthol	Lb.	101,602	163,803	204,244	332,913
Naphtha, methyl alcohol and alcohols and alcohol mixtures (nes)		—	—	2,486,820	3,456,762
Turpentine	Gall.	746,523	849,366	190,200	223,365
Glycol ethers and esters	Lb.	6,437,826	6,981,266	554,235	616,727
Sodium compounds	Cwt.	113,549	133,738	1,131,391	1,417,752
Styrene	Gall.	3,461,590	1,658,744	1,883,430	829,151
Vinyl acetate	Tons	9,313	4,902	1,338,386	570,758
Dyestuffs intermediates	Cwt.	9,121	28,090	524,682	971,003
Organic compounds (nes)		—	—	11,569,721	12,024,730
Synthetic organic dyestuffs and compounds	Cwt.	35,519	35,693	2,727,142	3,306,686
Titanium dioxide	,,	72,170	123,948	781,690	1,162,533
Other pigments	,,	177,829	225,138	628,581	705,413
Vitamins, their salts and esters		—	—	1,533,492	1,172,516
Antibiotics		—	—	742,903	1,260,142
Alkaloids		—	—	925,446	623,274
FERTILISERS					
Basic slag	Tons	91,673	110,318	737,078	906,112
Potassium chloride	Cwt.	11,053,070	10,751,099	9,067,872	8,919,243
Potassium sulphate	,,	258,299	314,335	262,607	308,323
Other fertilisers		—	—	1,363,665	1,847,383
PLASTICS MATERIALS					
Vinyl resins	Cwt.	124,298	172,905	1,746,728	2,208,783
Other synthetic resins	,,	193,881	272,739	2,933,667	3,774,559
Moulding powders	,,	29,789	81,760	501,509	1,631,946
Sheet, rod, tube, film and foil	,,	114,903	138,572	5,476,737	6,259,170
MISCELLANEOUS					
Chemicals and chemical materials and products (nes)		—	—	4,904,644	5,877,889
Chemical and gas machinery (nes)	Cwt.	22,401	35,029	944,878	1,426,227
Explosives	,,	5,657	10,005	232,529	214,110

EXPORTS OF ALL CHEMICALS TO PRINCIPAL MARKETS

	1955	1956	1957
Gold Coast	4,213,999	4,603,238	5,150,562
Nigeria	5,237,016	5,404,304	5,310,714
Union of South Africa	11,567,897	11,790,065	12,812,864
Rhodesia and Nyasaland	2,319,877	2,378,326	2,903,462
India	16,528,391	18,265,084	16,561,037
Pakistan	4,674,885	4,209,608	3,819,620
Singapore	4,051,548	4,654,770	4,115,235
Federation of Malaya	3,558,910	3,742,133	3,849,662
Ceylon	2,744,741	2,480,469	3,625,878
Hong Kong	3,150,676	3,587,470	4,326,776
Australia	19,446,670	17,614,339	22,312,989
New Zealand	7,867,215	7,282,165	8,492,912
Canada	7,792,195	8,291,969	8,519,245
Irish Republic	6,738,427	6,630,113	6,761,423
Finland	3,248,569	3,227,015	2,812,090
Sweden	6,159,640	6,700,049	7,361,956
Norway	3,334,152	3,672,868	4,216,467
Denmark	3,955,832	4,621,767	4,791,423
Western Germany	5,690,377	6,239,633	8,514,883
Netherlands	7,831,888	8,857,346	10,028,141
Belgium	5,261,889	6,083,781	6,578,885
France	6,651,164	7,745,331	8,581,701
Switzerland	2,492,626	3,206,630	3,224,886
Portugal	1,756,920	2,187,217	2,630,652
Italy	6,334,058	8,824,815	8,777,262
Netherlands Antilles	2,839,147	2,751,540	3,297,977
Iraq	2,206,649	2,350,173	2,679,261
Iran	1,956,128	2,089,181	3,367,554
Burma	2,759,792	3,124,790	4,238,338
Japan	1,258,728	2,286,376	2,286,247
United States of America	7,609,498	8,638,504	7,381,854
Brazil	311,465	2,348,506	2,689,480
Argentine Republic	4,628,688	3,320,771	5,442,375
Other foreign countries	2,825,850	3,326,436	4,122,480
Total for all Countries	**233,049,513**	**244,540,905**	**267,408,054**

Commercial News

Marked Increase in Hickson and Welch Group Profits

GROUP profits of Hickson and Welch (Holdings) for the year to 30 September last have risen sharply from £417,333 to £505,608, a 21 per cent increase. This compares with increases of 3 per cent and 46 per cent respectively in the two previous years.

Tax has absorbed £254,211 (£206,721 after crediting £8,000 previously provided) to leave a net profit of £251,397, against £210,612. Depreciation has taken £86,196 (£84,143).

A final dividend of 13½ per cent is being paid to make 17½ per cent for the year on the ordinary capital increased by £700,000 by a scrip issue. In 1955-56, a final of 11 per cent made a 15 per cent total on £550,000.

Benn Brothers Ltd.

Dividends recommended by Benn Brothers, proprietors of CHEMICAL AGE, for the half-year ended 31 December, 1957, are 3 per cent on preference shares (same) and 5 per cent interim on the ordinary shares (same).

ICI-Yorkshire Copper

Yorkshire Imperial Metals, the company in which it is proposed to merge the undertaking of the Yorkshire Copper works with the corresponding section of the metals division of Imperial Chemical Industries Ltd., has now been formed.

Details of the proposed merger between Yorkshire Copper and ICI were given in CHEMICAL AGE, 11 January, p. 130. The capital of the new company will be 50/50 owned by Yorkshire Copper and ICI.

T. and H. Smith

Manufacturing chemists, T. and H. Smith Ltd. record a lower group trading profit for the six months to 30 September, 1957, of £197,855 as against £283,957 for the previous year. The net profit is also down at £81,933 compared with £92,843 after tax of £88,215 (£135,215). Current liabilities amount to £686,626 (£467,926), including £151,575 (£95,464) due to bankers. Commitments total £56,700 (£52,500).

A dividend of 5 per cent for the period is being paid (10 per cent. for the year).

Gas Purification

A group deficit of £150,812 for the 15 months to 30 June, 1957, is announced by the Gas Purification and Chemical Co. This deficit has been incurred in taking up the losses of non-chemical subsidiaries amounting to £508,353. Wolsey Electronics have also suffered a setback caused by the removal to larger premises. This company's losses are stated to have since been recovered. Gas Purification Ltd. continues to be profitable, it is stated.

Group fixed assets are up from £481,132 to £849,300. Net current assets are £718.852 compared with £784,320.

E. Griffiths Hughes

Manufacturing chemists, E. Griffiths Hughes, owned by Griffith Hughes Proprietories, have made an offer to purchase all the £125,000 ordinary and £125,000 'A' ordinary of J. C. and J. Field Co. Ltd., manufacturers of toilet preparations, for cash at 12s 6d per 5s share. The offer is open until 10 February or not more than four weeks later and is conditional upon 90 per cent acceptance, or such lesser percentage as the purchaser may decide.

Thomas De La Rue

CIC consent has been given to Thomas De La Rue and Co., for the capitalisation of £926,000 of reserves for a 100 per cent scrip issue. One new 5s ordinary will be issued for each 5s ordinary share held. The old and new shares will be consolidated into 10s shares.

De La Rue state that issued ordinary capital has become disproportionately small in relation to the value of assets employed in the business, largely as the result of ploughing back a substantial proportion of profits over past years.

Farbenfabriken Bayer

It was announced on 23 January that Farbenfabriken have decided to issue DM 110 million shares at 115 per cent. Bayer's capital will then be increased to DM 660 million (£60 million).

NEW COMPANIES

DUST CONTROL PROCESSES LTD. Cap. £100. Designers, manufacturers and installers of plant, machinery and apparatus for preventing, abating, measuring or controlling the pollution of air, gas, vapour, liquids or solids, etc. Subscribers: Darlington Chemicals Ltd., Cockerton, Darlington; and K. C. Plumbe, Eggleshope House, Egglestone, Barnard Castle, and Darlington Chemicals (jointly).

FILTRATION CONSULTANTS (AFRICA), (AUSTRALASIA), (CANADA and US), (FRANCE), (GERMANY), and (HOLLAND) LTD. Six companies, each registered 23 January, and each with a capital of £550 in 500 'A' Shares of £1 and 1,000 'B' shares of 1s each. Objects: To carry on the business of engineers and consultants, designers and constructors of plants and other works for the collection and purification of water, sewage, industrial and other effluents etc. Subscribers are Gilbert Davis and A. B. Mainstone. Solicitors are Le Brasseur, Davis and Son, 32 Stow Hill, Newport, Mon.

H. AND C. SECURITIES LTD. Cap. £1,000. Investment trust company, etc. Directors: Sir Leonard C. Paton (director, Harrisons and Crosfield Ltd., etc.), H. O. Peake (director, Harrisons and Eastern Export Ltd., etc.), J. F. E. Gilchrist (director, Harrisons, King and Irwin, Ltd., etc.), G. O. Peake (director, Dillons Chemical Co. Ltd., etc.). Reg. office: 1/4 Great Tower Street, London EC3.

VACUUM METALLIZING PROCESSES LTD. Cap. £600. To carry out scientific, chemical and industrial researches and investigations, and to carry on the business of analysts, consultants, assayers, samplers and consulting and contracting chemical engineers, etc. Directors are not named. Solicitors: Slaughter and May, 18 Austin Friars, London EC2.

WOOD STREET DEVELOPMENTS LTD. Capital £5,000. Technical consultants, inventors, designers, and draughtsmen in regard to appliances, apparatus, instruments, machines, structures and processes connected with the engineering, chemical, nuclear, medical, horticultural, agricultural, oil or coal industries, etc. Directors: A. Frazer-Nash, 84 Kingston Hill, Kingston, Surrey; A. Woods. E. Aland and Mrs. D. M. Kehoe.

MORTGAGES AND CHARGES

A. BOAKE ROBERTS AND CO. LTD., London E. 17 Dec., deed securing additionally deb. stock of £600,000 issued by A. Boake Roberts and Co. (Holding) Ltd.; Charged on specified properties at Blackhorse Lane, Walthamstow, and Cuerdley, Widnes.

LONDON GAZETTE

Voluntary Winding-up

(A resolution for the voluntary winding-up of a company does not necessarily imply liabilities. Frequently it is for purposes of internal reconstruction and notice is purely formal.)

GENERAL DETERGENTS LTD., industrial and general chemists, regd. office, 30 Cornhill, London EC3. By special resolution, 10 January. Mr. H. Moore, 30 Cornhill, London EC3, appointed liquidator.

GRIMSHAW BROS. AND CO. LTD. Chemical manufacturers and merchants. Leslie Bowyer, 2 Booth Street, Manchester 2, appointed liquidator by the members.

Notice of Meeting

MERCK AND CO. (GREAT BRITAIN) LTD. General meeting of members, 14 February, for account of liquidator. All creditors have been or will be paid in full.

Amendments to Patent Rules

Amended rules making minor changes in the arrangements applying to patent applications and fees were laid before Parliament on 22 January by the Board of Trade. These rules include the introduction of a new service to the public by which information will be supplied as to whether any particular patent is in force, on payment of a nominal fee of 1s for the first patent and 6d for each succeeding one.

The new rules, which come into operation on 1 February, can be obtained from HM Stationery Office, price 2s 6d.

TRADE NOTES

New UK Nuclear Association

Ruston and Hornsby Ltd., Anchor Street Works, Lincoln, and J. L. Kier and Co. Ltd., 7 Lygon Place, Grosvenor Gardens, London SW1, have associated for the design, development and construction of nuclear power stations of 5 to 25 MW. output.

Changes of Address

The Staines company of Optical and Mechanical Devices have changed their title and address. They are being reformed as Optical-Mechanical (Instruments) Ltd., and will operate from 17 Station Road, Egham, Surrey. Telephone, Egham 3120.

New Metals and Chemicals Ltd. and Fleischmann (London) Ltd. have changed their address to Chancery House, Chancery Lane, London WC2.

US Company Expands in UK

The US company of High Voltage Engineering Corporation, Burlington, Mass., has acquired 51 per cent of the stock of High Voltage Servicing Co. Ltd., London. This is the first step in an expansion programme that will double the facilities for the installation and service of Van de Graaff particle accelerators. HVSC has represented the Burlington company since 1949 in maintenance and repair of Van de Graaff equipment.

Under Mr. Tom Fox, founder and managing director of HVSC, sales and engineering staffs will be more than doubled, with special attention given to training of personnel for installation and service. Eventually, HVSC will have responsibility for installation and maintenance of all Van de Graaff accelerators in Europe, Africa and eastwards to Calcutta.

Chemical Glassware Exports Up

QVF Ltd., chemical engineers in glass, of Fenton, Stoke-on-Trent, a member of the Triplex group of companies, report that in the last six months they have increased their exports from 28 per cent to over 40 per cent of their rising turnover. Mr. Brian H. Turpin, managing director, states that recent large orders have included plant and material for India, Switzerland, France, Canada and Finland.

New Boron Compound

Boron phosphate (BPO_4), a new addition to the '20 Mule Team' range of boron compounds, is now available in quantity from Borax Consolidated Ltd. Its properties suggest potential uses in the preparation of raw glazes and frits for glazing and enamelling processes; and as a catalyst in certain organic reactions. Full details of chemical and physical properties are available on request from the research and development department of Borax Consolidated Ltd., Borax House, Carlisle Place, London SW1.

Market Reports

HIGH LEVEL OF EXPORT ACTIVITY

LONDON There has been no special feature on the week and steady price conditions continue in most sections of the market although non-ferrous metal compounds are a notable exception. Home demand for industrial chemicals remains fairly satisfactory with a good intake against contracts, and export activity continues at a high level with a good volume of enquiry in circulation.

There has been renewed buying interest in the fertiliser market and some improvement in activity should be in evidence during the coming weeks. The coal-tar products market is moderately active with pitch finding a ready outlet on home and export account.

MANCHESTER Reasonably satisfactory trading conditions have been reported this week in most sections of the market for heavy chemical products. There has been a fair sprinkling of fresh enquiries covering a wide range, with both home users and shippers in the market, while existing commitments are being drawn against steadily. Quotations generally continue on a firm basis, the non-ferrous metal products still being the main exception. The demand for the fertilisers is showing signs of expansion in a number of directions. Most of the tar products are going steadily into consumption.

GLASGOW Although some sections of industry showed a slight decline during the past week, overall a steady volume of business has been transacted in the Scottish heavy chemical market, mainly in regard to current requirements. Some price alterations have been advised, but on the whole they have remained fairly firm. Apart from interest in forward requirements the position is rather quiet in connection with agricultural chemicals.

FOR YOUR DIARY

MONDAY 3 FEBRUARY

CS—Durham: Applebey Theatre. 8.15 p.m. Tilden lecture, 'Crystalline ion-exchanger' by Professor R. M. Barrer.

CS, RIC & Oxford University Alembic Club—Oxford: Inorganic Chemistry Laboratory, The University. 8.15 p.m. 'Steric hindrance in inorganic and analytical chemistry' by Dr. H. M. N. H. Irving.

OCCA & SCI—Hull: Royal Station Hotel. 7 p.m. 'New products from fatty acids' by M. R. Mills.

SCI—London: 14 Belgrave Square SW1. 6.30 p.m. 'The microbiological production of organic chemicals' by J. J. H. Hastings.

TUESDAY 4 FEBRUARY

CS—Nottingham: Chemistry Theatre, The University. 4.45 p.m. 'Some aspects of the chemistry of niobium and tantalum' by Dr. F. Fairbrother.

I Chem E—London: Geological Society, Burlington House, Piccadilly W1. 5.30 p.m. 'The turbulent flow of suspensions in pipes' by A. D. Maude and R. L. Whitmore, 'Sedimentation and fluidisation—part II. Heat transfer from a liquid-fluidised system to a tube wall' by A. E. Mitson and J. F. Richardson and 'Mass transfer between fluidised particles of a gas' by A. G. Bakhtiar and J. F. Richardson.

SCI Agriculture Group—London: 14 Belgrave Square SW1. 10.30 a.m. 'Mineralisation and immobilisation of nitrogen in soils' by Dr. G. W. Winsor, 'Transformations and movement of fertiliser nitrogen in light soil' by J. K. R. Gasser, 'Nitrogen fertilisers and the newer cereal varieties' by A. E. M. Hood and 'Nitrogen and the dairy cow' by Dr. M. J. Head.

WEDNESDAY 5 FEBRUARY

Incorporated Plant Engineers—Leicester: Bell Hotel. 7 p.m. 'Trade waste effluents' by S. J. Roberts.

Plastics Institute—Birmingham: James Watt Memorial Hall, Great Charles Street, 3. 6.30 p.m. 'Polyurethanes' by Dr. Weinbrunner.

Royal Society—London: Burlington House, Piccadilly W1. 3 p.m. Discussion on 'Experimental results with the Zeta apparatus on controlled thermonuclear reactions' opened by Sir John Cockcroft.

THURSDAY 6 FEBRUARY

CS—Bristol: Chemistry Department, The University. 5.15 p.m. 'The chemistry of the vegetable tannins' by Professor R. D. Haworth.

Polarographic Society—London: Cora Hotel, Upper Woburn Place WC1. 6 p.m. Annual general meeting.

RIC—Kingston: Technical College, Fassett Road. 6.30 p.m. 'The boron hydrides and their potential uses' by Professor H. J. Emeleus.

RIC & SCI—Leeds: Queen's Hotel. 7.30 p.m. 'The petroleum chemist's contribution to home life'

FRIDAY 7 FEBRUARY

Incorporated Plant Engineers—Birmingham: Imperial Hotel, Temple Street. 7.30 p.m. Annual dinner of Birmingham branch.

SAC—London: Chemical Society, Burlington House, Piccadilly W1. 6.30 p.m. Annual general meeting of the microchemistry group. 7 p.m. 'Applications of the Conway diffusion technique to the analysis of radioactive materials for trace materials' by J. K. Foreman and 'The use of long chain quaternary amine salts in the solvent extraction of metal ions' by R. Powell.

ICI and Competition

Speaking to Imperial Chemical Industries' employees in Singapore, Sir Alexander Fleck, chairman of ICI, said that business would be more difficult in Britain this year. There were signs that the company was meeting more competition and would have to make strong efforts to be as successful as last year.

NEW PATENTS

By permission of the Controller, HM Stationery Office, the following extracts are reproduced from the 'Official Journal (Patents)', which is available from the Patent Office (Sale Branch), 25 Southampton Buildings, Chancery Lane, London WC2, price 3s 3d including postage; annual subscription £8.

Specifications filed in connection with the acceptances in the following list will be open to public inspection on the dates shown. Opposition to the grant of a patent on any of the applications listed may be lodged by filing patents form 12 at any time within the prescribed period.

ACCEPTANCES

Open to public inspection on 26 February

Process for treating aluminous ores. Kaiser Aluminum & Chemical Corp. **790 970**

Process for the continuous treatment of a fibre fleece with an acid chlorite bleaching bath. Spinnfaser AG. **790 820**

Activation of aluminium. Koppers Co., Inc. **790 896**

Ion retardation method of separating solutes. Dow Chemical Co. **790 897**

Substituted cyclopentenes and methods of preparing same. Union Carbide Corp. [Divided out of 790 841.] **790 842**

Open to public inspection on 5 March

Manufacture of organic phosphorus compounds. Ministry of Supply. **791 590**

Manufacture of composite polymeric articles. Imperial Chemical Industries Ltd. **791 549**

Moulded polyethylene containers and methods of forming same. Heisler, J. S. and Heisler, A. **791 611**

Manufacture of compounds of the suprarenal cortex hormone series. Ciba Ltd. **791 400**

Production of methylol-substituted aliphatic ketones. Rheinpreussen AG Fuer Bergbau und Chemie. **791 541**

Method of redistributing fluorine throughout a catalyst mass. British Petroleum Co. Ltd. Porter, F. W. B., Turner, R. and Housam, E. C. **791 551**

Coating of nylon fabrics. United States Rubber Co. **791 618**

3.3.3-Trimethylolisopropanol and a process for its preparation. Rheinpreussen AG Fuer Bergbau und Chemie. **791 542**

Process for the production of 2-methylol-3-ketobutene (1, 2). Rheinpreussen AG Fuer Bergbau und Chemie. **791 543**

Purification of titanium tetrachloride by distillation. British Titan Products Co. Ltd. **791 651**

Apparatus for filtering liquids. White Filter Sales Co. **791 515**

Vapour condensing apparatus. Smith, R. J. S. **791 652**

Synthetic resin compositions. Aluminium Francais. **791 653**

Coloured cellulose acetate textile materials. Celanese Corp. of America. **791 391**

Mixing of particulate solid material with liquid. British Artificial Resin Co. Ltd. **791 554**

Preparation of copolymers. Polyplastic. **791 453**

Ammonia separation process. Chemical Construction Corp. **791 437**

Method and apparatus for the manufacture of artificial edible sausage casings. Freudenberg Komm.-Ges. Auf Aktien, C. **791 402**

Preparations containing morphine. Rabinovitch, J. **791 522**

Process for treating products having a low electric conductivity to reduce their tendency to electrostatic charging. Naamlooze Vennootschap Onderzoekingsinstituut Research. **791 476**

Aminobenzoic acid derivatives and the manufacture thereof. Upjohn Co. **791 599**

Preparation of 5-sulphur - substituted uracils. Armour & Co. **791 656**

Preparation of titanium dioxide. British Titan Products Co. Ltd. **791 657**

Preparation of a stabilised raney nickel catalyst. British Drug Houses Ltd. **791 658**

Aluminium coating processes. Solar Aircraft Co. **791 502**

Therapeutic composition including acetylation inhibitor. Horner Ltd., F. W. **791 404**

Recovery of phthalic acids. California Research Corp. **791 661**

Fluid-impervious graphitic articles and method of making same. Union Carbide Corp. **791 602**

Compositions containing griseofulvin. Glaxo Laboratories Ltd. [Cognate application 17554.] **791 603**

Fibrous glass-reinforced polymeric styrene moulding compositions. Koppers Co., Inc. **791 663**

Dimethyl-(phenyl)-phosphates for use as fuel additives. Ethyl Corp. **791 526**

Method for determining the surface tension and viscosity of materials. Novotny, A. **791 527**

Sulphonamides. Imperial Chemical Industries Ltd., Brimelow, H. C., and Vasey, C. H **791 529**

Adhesives. National Research Development Corp. **791 530**

Process for dyeing textile articles made from acrylonitrile containing polymers. Union Carbide Corp. **791,531**

Motor fuel and method of preparing same. Gulf Oil Corp. **791 393**

Gasoline fuel composition. Gulf Oil Corp. **791 394**

Composition for gasoline and method of preparing same. Gulf Research & Development Co. **791 395**

Motor fuel. Gulf Oil Corp. **791 396**

Metal complexes of polyazo dyestuffs. Sandoz Ltd. [Addition to 760 705.] **791 532**

Chemical reactor. Chempatents, Inc. **791 631**

Production of derivatives of 3, 5-dioxopyrazolidine. Geigy AG, J. R. **791 668**

Disazo dyestuffs derived from bis-aminopyrazoles. Imperial Chemical Industries Ltd. **791 483**

Funnels for pouring liquids. General Electric Co. Ltd. **791 484**

5-Chloro 8-acetoxyquinoline and germicidal compositions thereof. Solco Ges. Für Chemische Laboratorien. **791 409**

Impregnation of leather to render it water-repellent. Boehme Fettchemie Ges. **791 633**

Separation of potassium and sodium ions from a mixture of sodium and potassium chlorides. Soc. d'Etudes Chimiques pour l'Industrie et l'Agriculture. **791 410**

Silicon-containing thioalcohols and thioethers. Farbenfabriken Bayer AG. **791 609**

Production of ethylene and its gaseous homologues. Koppers Ges., H. **791 634**

Purification of melamine. Badische Anilin- & Soda-Fabrik AG. **791 536**

Coating aluminium with cellulose esters. Celanese Corp. of America. **791 638**

Process for the production of middle-distillate hydrocarbon oils. Esso Research & Engineering Co. **791 639**

Production of hard construction-plates from polyvinyl chloride. Chemische Werke Hüls AG. **791 567**

Preparing a stable suspension of a divalent metal salt in an oily medium. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **791 413**

(*Continued on next page*)

Products with a basis of mineral fibres and processes for obtaining them. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St.-Gobain, Chauny & Cirey. **791 538**

Marine white gasoline compositions containing oil-soluble alkylammonium dialkyl orthophosphates. Gulf Oil Corp. **791 397**

Aviation grade gasolines containing n-alkyl acid containing n-alkyl amine salts of dialkyl acid orthophosphates. Gulf Oil Corp. **791 398**

Cellulose triacetate filamentary materials. Celanese Corp. of America. **791 468**

Detergent compositions. Hedley & Co. Ltd., T. **791 415**

Production of substituted tetrahydro-oxazines. Boehringer, A., Boehringer, E., Liebrecht, I., Liebrecht, J., and List, W. Mayer-, [trading as Boehringer Sohn, C. H.,]. **791 416**

Barbiturate pharmaceutical preparations. Nicholas Proprietary, Ltd. **791 644**

Fine comminution of plastic masses, particularly ceramic mixtures. Ruemcke, [nee Slik], F. **791 645**

Filters. Eimco Corp. **791 418**

Process and apparatus for paper chromatography and paper electrophoresis. Schering AG. **791 570**

Method of and apparatus for the electrostatic purification of waste gases. Metallges, AG. **791 575**

10-(Halo-benzoyl)-3, 7-bis(dimethylamino) phenothiazines. National Cash Register Co. **791 426**

Producing mixed ammonium nitrate fertilisers. Commercial Solvents Corp. **791 647**

Method and apparatus for filtering liquids. White Filter Sales Co. [Divided out of 791 515.] **791 516**

Pesticidal ester salts of phosphorothiolothionic acid. Imperial Chemical Industries, Ltd. [Divided out of 783 281.] **791 588**

Manufacture of a vat dyestuff containing sulphur. Casella Farbwerke Mainkur AG. **791 498**

Dyeing cellulose acetate textile materials. Celanese Corp of America. [Divided out of 791 391.] **791 392**

Open to public inspection on 12 *March*

Bread improvement. British Soya Products Ltd. [Cognate applications 16633 and 31310.] **791 861**

Spraying apparatus. Tanning Equipment Ltd., Mitchell, R., and Wright, P. L. W. **791 862**

Processes for carrying out chemical reactions. Zakarian, G. **791 899**

Manufacture of compounds of the suprarenal cortex hormone series. Ciba Ltd. **791 914**

Elastomeric latices derived from diisocyanates and substances containing active hydrogen atoms. Du Pont De Nemours & Co, E. I. **791 851**

Elastomeric polyurethanes. Du Pont De Nemours & Co., E. I. **791 852**

Electrodes. Hanovia Chemical & Manufacturing Co. **791 915**

Acetone and phenol. California Research Corp. **791 759**

Elastomeric diisocyanate modified polyesters and polyalkylene ether glycols. Du Pont De Nemours & Co., E. I. **791 853**

Amino-propyl substituted caffeine derivatives and process for their manufacture. Farbwerke Hoechst AG. **791 761**

Antiviral substance produced by the fermentation of *Nocardia formica*. Merck & Co., Inc. **791 731**

Diethyl esters of dithiolisophthalic acids. Imperial Chemical Industries Ltd. **791 734**

Production of combustible gases from liquid hydrocarbons. Esso Research & Engineering Co. **791 754**

Production of combustible gases from liquid hydrocarbons. Esso Research & Engineering Co. **791 755 791 756 791 757 791 758**

Wet screening of solid particles and apparatus therefor. Stamicarbon N.V. [Addition to 791 858.] **791 858 791 859**

Chemical process and product. Du Pont De Nemours & Co., E. I. **791 854**

Substituted, benzindoles, intermediates therefor, and process for preparing same. Lilly & Co., E. **791 804**

Substituted indoles, intermediates therefor, and process for preparing same. Lilly & Co., E. **791 805**

Infra-red gas analysers. Parsons & Co. Ltd., C. A. [Cognate application 28475.] **791 737**

Flame-retarding compositions. Associated Lead Manufacturers Ltd., and Read, N. J. **791 802**

Acrylonitrile polymers. Imperial Chemical Industries Ltd. **791 765**

Pyrazole derivatives. May & Baker Ltd. **791 688**

Recovering olefin polymers. Esso Research & Engineering Co. **791 920**

Nematocidal compositions. Virginia-Carolina Chemical Corp. **791 818**

Pigmented compositions and colouring of textiles. Rohm & Haas Co. **791 767**

Heterocyclic phosphorus - containing halides and their production. Union Carbide Corp. **791 739**

Process for preparing fluosilicates. Grace & Co., W. R. **791 768**

Preparation of tropinone. Sadolin & Holmblad Aktie-Selskabet. **791 770**

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Deputy Director of Research and Research Officers
Institute of Applied Technical Research

Applications are invited for the following posts in the Institute, which is concerned with technical research and development in the processing of the diverse natural raw products of Nigeria and the assessment of their scientific, nutritional and industrial importance.

(a) **Deputy Director of Research**
Qualifications: Good academic qualifications (preferably an honours degree in chemistry or chemical engineering or equivalent professional qualifications) and ability to plan and co-ordinate long and short term projects essential. Experience in industry and of one or more of the problems arising in the processing of natural oils, food and its fermentation, rubber, paper and natural fibres an advantage.
Duties: Under the direction of the Director of Research, to plan and control research in industrial technology arising from the processing of Nigerian raw materials; to study the technical requirements of new industries and to adapt to Nigerian conditions solutions arrived at elsewhere; to assist in the administration and development of the Institute and to provide the necessary direction of its day-to-day work.
Emoluments: Not exceeding £2,500 per annum.

(b) **Research Officers**
Qualifications: Good degree in chemistry, physics or biochemistry (or equivalent professional qualification). Ability to think clearly and a flair for improvisation essential. Age 25-31. Women candidates would be considered.
Duties: To work in a team in the laboratory of the Institute on the examination of materials, with opportunities for individual research.
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OFFICIAL APPOINTMENTS: continued

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MELANOID LIMITED

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The successful applicant will be responsible for the general control of production and development. Preference will be given to candidates with a B.Sc or A.R.I.C. qualification.

Commencing salary will be not less than £1,250 per annum. The post is pensionable and the successful candidate may be required to pass a medical examination.

Applications, stating age, qualifications and experience, together with details of present and previous appointments and the names of two referees, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6 Augustus Road, Edgbaston, Birmingham 15. (Melanoid Limited is a subsidiary of the West Midlands Gas Board). Applications should be received not later than the 8th February, 1958.

J. SWAN,
Secretary to the Board.

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